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ABSTRACT

The first of three main sections in this review of research covers current and recent developments in the interfacing of education and technology in Australia, with particular attention paid to policy initiatives adopted by governments, industry, academic institutions, and the community with respect to the interface. The second part reviews alternative futures, again focusing on Australia. Feasible international and national scenarios are explored and attention is paid to the shorter term alternative futures possible for technology and education and their importance to the interface. The third section is concerned with issues raised by such interfacing. An exhaustive survey of all issues involved in considering the education-technology interface is not intended; rather, this section brings together issues that have been raised in discussions on education and technology. Conclusions are drawn concerning the present state of this debate, and its implications for policy development and implementation. A bibliography, annotated bibliography, list of persons consulted, and list of persons who submitted documents are included. (Author/THC)

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EDUCATION AND POLITY

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Interface Between Education and Technology AUSTRALIA

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EDUCATION AND POLITY 1

Interface Between Education and Technology: AUSTRALIA

Ian Birch
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Keith Punch

University of Western Australia

UNESCO REGIONAL OFFICE FOR EDUCATION
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PREFACE

The APEID Interdisciplinary Meeting on Education within the Context of Alternative Futures (Bangkok, 2-8 November 1983) had recommended that the countries participating in it should be approached for making studies, in the context of futures, on interface of education with four areas, namely, communication; employment and leisure; state policy; and technology. The brief outline of such studies had been established jointly at the aforesaid Meeting. A fifth area was added on the recommendation of the Ninth Regional Consultation Meeting on APEID (Bangkok, March 1984) under the title 'education and urban development'.

Consequently, Unesco approached the participants of the Meeting to indicate their interest in undertaking interface studies as recommended.

The studies were then commissioned during 1984 and were conducted by interdisciplinary teams: two in Australia, two in India, one in Japan, one in Malaysia and one in the Republic of Korea. These seven studies are published in a series entitled "Education and Polity".

Grateful acknowledgement is made to the three authors of this study, who are staff members of the University of Western Australia, and to the institutions and enterprises which extended co-operation in the preparation of the study.

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Chapter One

INTRODUCTION

Futures and Education published by UNESCO in 1984 provides the framework for the study which is reported on in this document. It was noted in that document that "futures studies designed for an educational perspective should firstly be rooted in holistic concerns so as to avoid fragmented distortions" and that such studies having been completed, the next stage required was in-depth studies between education and other sectors. The authors of this document were commissioned to take up one of the interface studies – namely that of education and technology – and, in particular, they were invited to consider policies proposed or already in place in Australia.

This report of the research is divided into three main sections, constituting chapters two, three and four. In chapter two, a survey of current and recent developments in Australia with respect to the interface between education and technology is presented. Particular attention is paid to policy initiatives adopted by governments, industry, academic institutions and the community with respect to the interface. Chapter three reviews the interface in the light of alternative futures, again with particular reference to Australia. Feasible international and national futures scenarios are explored and particular reference is made to the shorter term alternative futures possible for technology and education and their importance to the interfacing of the two. Chapter four of this report is concerned with the issues raised in interfacing education and technology. Those issues have not yet been comprehensively reported on in the literature, far less appropriately researched. This chapter is not intended as an exhaustive survey of all the issues involved in considering the education-technology interface. Rather, it brings together those issues which are raised in the discussion about education and technology in Australia. A final chapter contains some concluding remarks about the material presented in chapters two, three and four, particularly with respect to the present state of the debate, and its implications for policy development and implementation.

Included in the report also are an annotated bibliography, a full bibliography, and a list of persons and organizations consulted in this research.

It became very evident early in this study that nothing more than an exploratory statement was the likely outcome of this research given the enormous amount of literature on education and technology, the numbers concerned with the interface and their very diverse interests, the lack of any formal mechanism for disseminating information on the interface of education and technology, the geographical and intellectual scope of the Australian debate and the expectation of a report completed in a comparatively short time.

In view of the above and the need for constraint in reporting, the researchers have been confined principally to representing key select developments in the discussion of the interface in chapter two, to treating the question of futures in a descriptive rather than analytical fashion in chapter three, and to mentioning the issues in chapter four in a summary style, the preference being to map the significant issues leaving their resolution to future research.

It is appropriate to note at this point the significant contribution to this project of Ms Karen McArdle and Mr Gary Burke in terms of their research assistance and writing, and Ms Ann Watt who had responsibility for the typing of the report. Acknowledgement is also made of the very many people who made themselves available for interviews, provided literature for the research and who expressed interest in and offered comment and criticisms about the project.

A major formulative problem inherent in a study such as this is that of definition. It became clear very early in this research that the concept of futures was as diffuse as that reported in *Futures and Education* (pp 49-9). The comparatively few who expressed concern for future studies of futures were mostly concerned with the short-term future and in terms of a planning model. As will be evident from chapter three, a broader perspective is encouraged in this study.

"Education" is treated in what follows in a broad but formal sense. Formal education in Australia embraces pre-school, primary, secondary and tertiary education with the latter designation including technical and further education as well as formal education in universities and colleges of advanced education. There is also, of course, education which falls outside this categorisation such as that

which may be described as non-formal as well as that which occurs within industry, commerce and the public service. Given the strong formal systems of education evident in Australia and their subjection to government control, the interface addressed in this research is principally that between technology and the formal system of education.

The term "technology" is a very elusive one, as any reading of the literature readily indicates. The immediate experience of many school teachers is one of technology involving the introduction of and use of microcomputers in classrooms. Problems and issues associated with technology in this view are canvassed in this study but a definition of technology in these terms is too restricted. Even the wider accommodation of satellites and other forms of communication within the definition of technology is regarded as being still limited.[1]

Rather technology in this study is seen as a broad term embracing the "new" technologies mentioned above and those generally described as high technology. Only such a broad definition will enable a full consideration of the interface between education and technology.

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[1] It should be noted that, since other studies have been commissioned on the interface between education and communication, the present research has not focussed on issues and development related to satellites and communications technology generally.

Chapter Two

AUSTRALIAN CONTEXT

Initiatives in Education and Technology are being taken in Australia by the following sectors: (1) Federal Government; (2) State Governments; (3) Industry; (4) Universities/Research Centres; and (5) the Community.

At each level a wide range of initiatives have been taken over a number of years. There are, however, certain pivotal initiatives which have shaped the continuing debate and which provide direction to a consideration of educational and technological issues in the future.

The ASTEC Technological Change Committee

A committee of Inquiry into Technological change in Australia established in 1978 released its report in 1980 which became known as the Myers Report on Technological Change. This constituted the first major Government initiative looking specifically at technological change. As a result of its recommendations a Technological Change Committee was established as a Standing Committee of the Australian Science and Technology Council (ASTEC). The ASTEC Technological Change Committee is an advisory body charged with the task of evaluating the direct and indirect effects of technological change at a national level, taking into account social, economic and technological effects. Its terms of reference embrace a wide range of functions including a continuing review of trends in technological change in Australia and the enhancement of community awareness of issues occurring as the result of such change. It has, therefore, both an evaluative and a proactive function. Its terms of reference are as follows:

1. The ASTEC Technological Change Committee is to maintain a continuing review of the processes and trends in technological change in Australia and elsewhere, and evaluate and report on the direct and indirect effects at the national level including social, economic and technological effects.

2. The Committee is to identify and evaluate new and changing technologies of importance to Australia, and factors favouring, or restraints impeding, the introduction or diffusion within Australia of new or existing technologies.

3. The Committee is to consider community attitudes recognising the need to increase the national community awareness and understanding of issues arising as the result of technological change.

4. The Committee is to carry out studies of technological change as required above and also in response to requests from ASTEC, noting that ASTEC may receive requests from the Commonwealth Government.

5. The Committee is to report to ASTEC making recommendations, where appropriate; aimed at deriving maximum benefit to Australia from technological change.

In June 1983, the ASTEC Technological Change Committee produced a report to the Prime Minister entitled *Technological Change and Employment.* The report provided an exploratory overview of the recently observed effects of technological change on the levels and nature of employment. Labour market trends in Australia are crucial to the Education Technology debate. In a context of high youth unemployment, there is particular concern over the direct labour-displacing effects of technology and considerable debate concerning the potential of technological change to create employment. The ASTEC Committee recognized this by agreeing that, in general, process technology directly displaces labour but whether there will be a net decline in jobs depends on a number of factors including, for instance, the degree of competitive advantage afforded by the introduction of technology. Failure to maintain process innovations may lead to a reduction of competitiveness. Indirect employment may however be created as a result of new technology products.

Whilst the level of job creation or job loss is unclear, there is widespread agreement that the nature of work will change. The coupling of Education and Technology in debate is increasingly common; education is being looked to, to equip young people for a changing labour market. Whilst change is certain, there is little agreement concerning the nature of change in the labour market and, therefore, the skills required from the education system. The

ASTEC Technological Change Committee takes the point of view that a higher order of skills will be required; to take maximum advantage of technological change it is essential, the committee states, to invest in human skills, not just in equipment.

The earliest investment in human capital needs to be in schools. The committee were concerned that less than 40 per cent of young people aged seventeen years were enrolled full-time in the final years of secondary school in Australia. In Japan and the United States of America the participation rates are greater than 80 per cent. A second cause for concern is the decline in overall participation of young people in higher education. To address these concerns the Committee suggested an extension of the period of formal education to age sixteen (and later to age seventeen) with science, technology and mathematics as core subjects until at least Year 10. Financial incentives for young people to obtain qualifications as a basis for long-term employment were put forward as a recommendation by the Committee to address the low participation rates in higher education. The following recommendations were made concerning Education and passed on to the Australian Education Council (AEC).

1. That the Government develop a co-ordinated system of financial support which encourages young people to lengthen their education, obtaining qualifications useful as a basis for long-term employment, as a preferable and financially attractive alternative to unemployment benefits.

2. That the Minister for Education and Youth Affairs, in consultation with bodies active in the formulation of education policy, in particular the AEC, be asked to develop a comprehensive approach to the education and training of young people for adaptability to technological change, giving attention to:

a) lengthening the period spent in formal and informal education;

b) developing skills in literacy and numeracy within a broadly-based education;

c) providing the opportunity for all students to obtain an adequate knowledge of science, mathematics and technology;

d) providing the opportunity for all students to develop skills, including computer literacy and keyboard skills, that are needed in an information based society;

e) ensuring that girls at school are aware of their need to acquire skills to enable them to move into a wider range of occupation, including emerging occupations;

f) increasing participation in higher education and ensuring that adequate numbers undertake studies in the sciences, technologies and mathematics which are appropriate for future occupational needs; and

g) developing wider training opportunities in technical and further education, available in units that can be integrated to form a broad base of skills and understanding.

The ASTEC Technological Change Committee also addressed the issue of retraining the workforce as part of the investment in human capital. The committee recognized that whilst the Department of Employment and Industrial Relations administers training programmes, these are mainly a response to the unemployment problems of young people; there is scope for the training of older unemployed workers and employed workers to upgrade their skills. The committee saw the issue of matching industry demands with skills training programmes as being worthy of the Government's urgent attention. The following recommendations were made:

1. That, as training and retraining are of major importance in the adaptation of the workforce to technological change, the Government take action to improve the provision of flexible opportunities for individuals to develop or upgrade skills as circumstances change during their working lifetime. Urgent attention is needed in relation to:

a) the development of consultation and co-operation between the various bodies with responsibilities for and interests in training and retraining, to optimise the links between courses and needs; such bodies to include the Commonwealth Tertiary Education Commission, the National Training Council and the Departments of Education and Youth Affairs, Employment and Industrial Relations, Industry and Commerce, and Science and Technology;

b) the effectiveness of existing programmes;

c) whether existing programmes are sufficiently diverse to meet the consequences of technological change which has already occurred and to prepare for further such changes;

d) whether particular categories of employees, e.g. women, migrants and ageing workers have particular training and retraining needs;

e) the relative responsibilities and roles of employers, unions and governments in the provision of training and retraining programmes; including

f) the relevance of apprenticeship schemes; and

g) the collection, as a high priority, of up-to-date information on present and future manpower needs, and to the dissemination, publicising and evaluation of the usage of such information.

2. That the Government appoint an independent committee as the most effective means of reviewing the above matters and recommending appropriate action programmes as a matter of urgency.

3. That the Government in consultation with women's organisations, including the National Women's Advisory Council and appropriate offices within Departments, including the Office of the Status of Women and the Women's Bureau, initiate the conduct of a study aimed at increasing understanding of the reasons for the concentration of women in occupations that are at risk as a result of technological change and formulating policies to encourage their participation in a wide range of occupations less subject to those risks.

National technology strategy

In April of 1983 the current Australian Labour Party Government held a National Economic Summit which included all sectors of Australian Industry and Commerce. Its final communique considered the significance of technology in our economic base. A National Technology Conference was subsequently held in Canberra in September 1983 to establish directions for Australia's economic,

social and technological development. The Department of Science and Technology, the Federal Government body with responsibility for science and technology, has developed a National Technology Strategy. The first discussion draft was produced in April of 1984 was widely circulated and is currently being redrafted.

The National Technology Strategy echoes the principles of the ASTEC Committee in its stance on the proposed directions for education, in both its perception of people as one of the resources to be developed for economic growth and the call to education to equip people to respond positively to change. The concept of re-training the workforce to meet changing needs is a third principle on which the educational recommendations of the strategy are based.

The objectives of the National Technology Strategy in relation to Education focus primarily on the improvement of skills and enhancing skills flexibility. The strategy seeks to address some of the issues raised by the ASTEC Technological Change Committee, looking to improve general levels of education by increasing education retention rates and increasing participation in courses related to technological change at secondary and tertiary levels of education, courses such as science, technology, management and business. The strategy also seeks to promote a recognition by Australian employers of their responsibility for skill development. The following long-term and short-term actions are suggested.

Long-term:

1. Promote wider acceptance in the community of further education, continuing education and re-training, and of the value of general education.

2. Raise the school leaving age.

3. Develop a major programme to build up the educational infrastructure to enable it to accommodate the increased numbers of students implicit in the above targets.

4. Remove financial, social and regional barriers to further education.

5. Increase the use of industrial segments in science and applied science courses at tertiary education institutions.

6. Ensure that teaching and training skills and facilities are continuously upgraded in order to adapt to and keep pace with structural and technological change.

7. Examine existing and new means of promoting training and education, such as:

a) use of foreign investment, purchasing offsets and other industry policies to stimulate appropriate training and education;

b) personal and corporate taxation concessions or incentives; and

c) training rights.

8. Increase the range of education and training courses available to mature age students.

Short-term:

1. Monitor progress towards, and revise if necessary, the target education participation rates.

2. Develop a public awareness campaign to influence the perception of young people about the value of education.

3. Ensure that teachers are able to update and extend their knowledge and awareness of science and technology.

4. Establish the proposed National Science Centre.

5. Place greater emphasis on management education, particularly on the management of technological change.

6. Expand existing training schemes until at least one per cent of the workforce is retrained each year:

a) Trade and Skills Training Programmes;

b) National Training Council;

c) Work Experience and Training for Young Persons;

d) Special Training for Disadvantaged Groups;

7. Review union approaches to adult apprenticeships and sandwich courses involving work experience.

8. Examine the possibility that junior wage rates inhibit the provision of training.

9. Commence a long-term programme to make the community fully conversant with technology issues by including such issues in curricula.

Eight thousand copies of the draft strategy were distributed and the document is currently being revised in the light of these responses. Approximately a third of responses received to date focussed on the educational recommendations of which most related to school retention and participation rates; there was some concern that the draft document considered quantity rather than quality of education and that the role of some sectors was not fully understood.

In the area of research and development, action strategies are presented which aim to produce a vital and flexible research and development system to underpin Australia's overall technological capability. Significant amongst these are the objectives of ensuring that young and able researchers at the peak of their activity are able to obtain employment in the research and development system and the desire to couple the tertiary education research and development effort more effectively to the needs of commerce, industry and the community so that by 1995/6 there is significant private sector funding.

The long term action steps require an adequate supply of well-trained researchers by increasing participation in undergraduate and postgraduate education and increasing the number of non-tenured positions in tertiary education institutions. Short term actions suggested are an increase in funding for basic research through the Australian Research Grants Scheme and the Commonwealth Tertiary Education Commission and increasing the relevance of research and development in tertiary institutions to commerce, industry and the community through arrangements such as the National Research Fellowships Scheme.

National Research Fellowships Scheme

The National Research Fellowships Scheme provides opportunities for individuals and research teams to undertake research of national significance. A scheme of research grants for researchers in biotechnology has been established for 1985 and the Teaching Company Scheme which places promising researchers from tertiary institutions into industrial companies will then start.

The emphasis on increasing participation in undergraduate and postgraduate education and developing Australia's research interests has met with criticism from tertiary institutions working to tight budgets and substantial cuts to the funding of the Government's own research institute CRIRO. Concern has also been expressed at the Government's emphasis on applied research projects, which is seen by some as threatening funding for basic research and in some cases as threatening fundamental academic freedom by allowing commercial interests to influence the direction of scientific research.

South Australian technology strategy

Whilst each state and territory has a Minister with responsibility for Technology, portfolio organization varies. South Australia is the only state in which the portfolios for Education and Technology are combined. South Australia has, in fact, produced its own State Technology Strategy. The strategies four main objectives are:

1. a strong and diverse economy;
2. a wide and equitable distribution of wealth;
3. protection of human rights;
4. education throughout life.

Both the ASTEC Committee and the National Technology Strategy approach education as a means of updating a "human resource" and preparing people for changing labour markets. The South Australian Strategy takes a more humanistic approach; this is demonstrated by its foundations on two basic principles which require technology to meet people's requirements rather than people meeting technology's requirements. The principles are:

1. Technology is only desirable where it results in net economic, ecological and social benefits to South Australians.

2. The political, civil and human rights of both individuals and groups should not be adversely affectd by the application of technology.

Within the strategy, the South Australian Government's aims are to:

1. Increase public understanding of the relationship between technology and political, economic, social, and ecological change;

2. Improve the ability of people to adapt to technology-induced change;

3. Increase the State's intellectual and creative resources and work force skills;

4. Improve entrepreneurial and self-realising skills; and

5. Provide a broad-base education for all throughout life.

The South Australian Strategy and the National Technology Strategy both concern themselves with the need for education to address the development of a general knowledge of technology and of the necessary life skills to handle rapid change. The South Australian Strategy does not restrict itself, however, to a consideration of acquiring an understanding of technology and acquiring flexible skills; it seeks other qualities in its citizens including,

1. A higher level of self-starting and entrepreneurial skills.

2. A constructive yet questioning attitude to technology.

3. A recognition of the relationship between science and technology and social, economic and ecological change.

4. A commitment to equity in sharing the benefits and costs of technological change.

5. A world view, a greater concern for global as well as national and regional problems.

South Australian Task Force on Education and Technology

In order to assist with the implementation of its strategy, the South Australian Government has appointed a Task Force on Education and Technology, whose functions are:

1. To identify and describe the features of an education system that responds to and, where possible, anticipates the needs of the South Australian Community in which technology and change are major features.

2. To establish a priority of initiatives necessary to help the education system better to play its key role in relation to technology, change and the future development of South Australia. These initiatives will derive from: (a) present strengths and opportunities; (b) present deficiencies; and (c) consultation, in relation to technology in the education system. They will also draw upon relevant experience interstate and overseas.

3. To prepare plans for and act as a catalyst in the implementation of the proposed initiatives.

4. To plan strategies to raise the level of community involvement in discussions and activities relating to an understanding of and participation in the technological society.

5. To devise means of monitoring the extent and effectiveness of the proposed changes to the education system.

The Task Force will report its findings to the Minister for Education and Technology.

US-Australia Joint Seminar : The future impact of technology on work and education

Clearly, a major focus of Government thinking in relation to Technology and Education, is the future of work and labour market requirements. In September 1984, a US-Australia Joint Seminar was held at Monash University in Melbourne, supported by funds from the National Science Foundation in the USA and the Department of Science and Technology under US-Australia Co-operative Science Programme. The seminar was titled – The Future Impact of Technology on Work and Education. By holding a joint seminar, it was hoped to facilitate an exchange of information between scholars in the two countries, to provide the opportunity for further collaborative research and to compile information concerning current thinking and research results to be disseminated widely.

The foundations on which technology and labour market strategies are based in Australia were questioned, in particular the

view that technology will increase the skill requirements of jobs in the future. A trend towards fragmentation of work into smaller and simpler processes was demonstrated by analogy with the United States of America where jobs in low-skill occupational areas are expanding more quickly than in any other occupational category.

The so-called "orthodox view" of labour market trends was questioned; a view which claims that recent years have seen an increase in the demand for skills and that this trend will continue; it is implied that this is a result of technological change. It was argued that it is more accurate to say that both ends of the skills demand dimension are rising and that a shift in the balance between white collar and blue collar employment cannot be equated with a shift towards higher skills demand.

Richard Sweet states from his research findings that, amongst teenagers, employment growth was most significant in part-time, low skilled jobs requiring minimal vocational preparation. In absolute terms the greatest growth in adult employment was in the services sector and whilst growth occurred in some highly skilled occupations this was principally due to increased Government expenditure in the labour-intensive community services and financial services sector.

This questioning of the skill requirements of the workforce of the future has implications for Government policy which is based on as assumption that greater skills will be required. If technology reduces the need for highly skilled labour, as Sweet claims, demand for highly skilled people may fall short of supply and underemployment may ensue. If technology increases the requirements for skilled labour the educational system must be expanded and curriculum must address the skills areas that will be in demand.

Whilst the conference elicited agreement that general education rather than strictly vocational education was the best way to prepare students for work in a technological future, there was no formal discussion concerning what the content of this general education should be. The skills of a general education also need to be considered and some suggestions from the seminar were the development of abstract and critical thinking, learning how to learn, how to be flexible in thinking and actions, how to become entrepreneurial and the skills of communication necessary for industrial democracy.

Criticism was levelled at the Government's current plans for meeting stated national educational objectives – providing greater opportunities for participation of disadvantaged groups and of meeting the needs of the economy in a period of technological and structural change. Greater opportunities for the disadvantaged, it was claimed, are being promoted mainly by encouraging them to stay on at schools in the hope that the effect of longer schooling will be a reduction in unemployment.

Gerald Burke argued that the Government's objectives of encouraging people to stay on at school will not be achieved as disadvantaged students are unlikely to be catered for when resources per student have already declined and only marginal funding is to be provided for any increase in enrolments. Education has fallen from 9 per cent of total Commonwealth outlays in 1976-1977 to 7.2 per cent in 1988-1984. As a percentage of GDP, total State and Commonwealth outlays fell from 6.4 per cent in 1977-1978 to about 5.7 per cent in 1983-1984. Rates of participation at school are now increasing but the federal Government, Burke maintained, are reluctant to fund the increased demand and are seeking ways to reduce the cost of the places it does provide. He suggested that Commonwealth policies on the nature of education – levels, fields of study and type of curriculum – appear to be based too heavily on an *asserted* relationship between education and employment. The national priorities do not consider the possibilities that:

1. the growth in absolute number of jobs in sciences and technologies in Australia may not be large even if the economy grows quite rapidly;

2. the level of skill and education required may decrease;

3. hours of work and age of retirement may decline and unemployment remain high; leading to

4. increased inequality of opportunity.

The difficult task ahead, Burke concluded, is to find ways of creating support for the funding of broadly based education which recognises the considerable uncertainties of the future and the likelihood of continuing and even growing employment difficulties for which more education is, he claims, an insufficient remedy.

Commission for the future

The need to promote an understanding of the changing nature of work and the social impact of technological change has been addressed at Federal Government level by the Minister for Science and Technology, Barry Jones. (The portfolios of Science and Technology have now been altered and Barry Jones is now the Minister for Science.) An annual budget of $750,000 has been set aside to fund a small independent Commission for the Future. To be established early in 1985, the Commission aims to raise community awareness and understanding of the social and community impact of technological change and to stimulate debate about making personal choices on future options.

It will not be an advisory body to Government but will stimulate public debate on the long term implications of technology-based social change. It is anticipated that money will mainly be spent on research and publications and educational institutions, particularly schools, will be an important focus of the Commission. As yet details of its composition and terms of reference are unavailable.

Commonwealth Schools Commission – National Advisory Committee on Computers in Schools

Computers have been used in Australian schools for more than a decade and much of the initial impetus originates from enthusiatic teachers and parents. In Australia, Education in schools is the responsibility of the States; there has been great variation between schools and education systems, therefore, in the rate of development. In 1983, the Commonwealth Schools Commission appointed a National Advisory Committee on Computers in Schools to advise on a National Computers in Schools Programme. The National Advisory Committee on Computers in Schools was given the following terms of reference:

The National Advisory Committee on Computers in Schools will provide advice to the Commonwealth Schools Commission on a broad range of matters relating to schools computing. In particular, it should provide advice on:

1. The use of computers in schools as they relate to the educational needs of boys and girls enrolled in primary, secondary and special schools;

2. The rationale for a national programme, including desirable short and long term education, social and economic outcomes;

3. An implementation plan, and associated guidelines, for the introduction of a National Schools Computing Programme into primary, secondary and special schools, including its integration with State and non-government schools policies and provisions. This plan will include options for the allocation of funds among States and sectors, advice on desirable minimum standards of provision, and on ways of achieving an equitable sharing of resources and services across Australia;

4. A plan for generating and supporting discussion and awareness within the community and especially within school communities of school computing and its applications;

5. Evaluation activities relating to computing in schools and to the provision and operation of the proposed national programme;

A report, *Teaching, Learning and Computers* was produced in October of 1983 and an information kit concerning its recommendations in 1984. Recommendations were made in the areas of Curriculum Development; Professional Development; Support Services; Software/Courseware; Hardware; and Organization.

A total of 52 recommendations were made but the following issues were identified as priorities by the Commonwealth:

1. Professional development relevant to computers should be available to teachers, parents and other members of the community.

2. Computer awareness courses should be available to students.

3. Uses for computers should be developed in as wide a range of subject areas as possible.

4. Focus of the programme should be on secondary schools in 1984.

The committee set out a rationale for a National Computer Education Programme, based on a belief that it is essential to the

well-being of Australia to provide students with knowledge of the electronic information technologies; if this does not happen, it states, Australia will be severely disadvantaged in relation to other countries.

A national programme was seen as ensuring schools have access to computing for all students and as giving a high priority to encouraging schools and schools systems to implement curricula in ways which make special provision for the removal and prevention of inequalities based on gender, socio-economic, cultural differences and regional location. A national programme, it was claimed, could assist in the reduction of the duplication of effort that is already occurring and assist school authorities in the selection of equipment. The committee believed there to be advantages in developing national educational guidelines and specifications for hardware and software as well as fostering or commissioning national research and evaluation and disseminating the results.

The programme would also provide the means for determining software needs, establishing standards and guidelines for developing software, co-ordinating production, and promoting the products to attract the attention of other countries. Finally, the Committee believed that a broader programme on the use of computers in schools would contribute to the national well-being by enabling all students to become "technically more aware" and, following the orthodox view, enabling some students to develop higher level skills which will contribute to their employment.

Guidelines for a co-ordinating structure were designed to forge links between State and Federal levels and Government and non-Government Education systems and to facilitate the Government allocation of $6.2 million for 1984, part of a $15 million commitment between 1984-6. Two statements of dissent were recorded in the document, one on behalf of the New South Wales Department of Education and one from the representative of the Australian Council of State School Organisations, in which disagreement was recorded concerning the recommended hardware.

To date, the success of the co-ordinating structure in unclear. Information concerning computing policy statements from the States is in most cases readily available yet exactly the extent to which the policies are being implemented is unclear. Information concerning initiatives in computer education was not forthcoming from some

education authorities and there was some admission that departments, as yet, had not been able to come to terms with the issues involved in computer education. It would be true to say that some confusion and duplication between states still exists, despite the National Computer Education Programme.

Commonwealth/State Advisory Committee on the Educational use of Communications Technology

In the area of the educational use of communications technology, forward planning and trials have taken place. In October 1982 the Australian Education Council established the Commonwealth/State Advisory Committee on the Educational Use of Communications Technology (ACEUCT). It was composed of representatives from education authorities in the States and Territories and consultants from the universities, colleges of advanced education and technical and further education sectors. In August 1984 ACEUCT produced a discussion paper on the Educational Use of the Australian Communications Satellite System. The domestic satellite will be launched in 1985 and will be in routine operation by the beginning of 1986.

Whilst there are many potential educational uses of the system, they fall into three major groups as described by ACEUCT:

1. Broadcast ('one point-to-many'); for example the beaming of educational films direct to schools, and specially prepared radio and TV programmes to meet specific needs of correspondence students.

2. Point to point applications (or 'point-to-multipoint'); for example the transmission of data between head office and regional offices for administrative purposes.

3. Interactive applications; for example School of the Air networks, counselling, conferencing, computer-assisted instruction.

Examples of services that might be implemented are:

1. The provision of enhanced services for distance education, for example services based on computer resources, electronic mail, TV download.

2. The development of links between schools and data bases of curriculum and administrative material.

3. Computer-linking for lesson-exchanges or sessions allowing regular or ad hoc professional contact using interactive TV.

The educational uses were diverse and likely to be more apparent, the ACEUCT states, as people became aware firstly of using the new technology as an alternative means of delivering existing services and secondly as a means of achieving new educational goals.

As with computer education, the states are in different stages of preparedness for the advent of the domestic satellite system. Some states have lodged expressions of interest with the controlling company Aussat Pty Ltd. The South Australian Telecommunication network SATNET, covering the whole of the State, is being established for educational purposes and many activities are taking place which make use of communications technology. South Australia seems to be in advance of the other states in that proposals for usage of the satellite and long-term requirement have been made. A task force has also been formed to co-ordinate the future communication requirements of distance education and departmental administration.

In order to improve the preparedness of education authorities, ACEUCT indicated a need for co-ordination of educational trials on the satellite; a need for educators to be made aware of the educational relevance of the technology to encourage them to build on the success of trial applications others have experienced and to avoid unnecessary repetition of earlier trials. A need for additional opportunities for educators to discuss and develop common approaches to the use of satellites and other telecommunications was indicated, to avoid the expense of independent but similar approaches and result in lower equipment price thresholds.

Australian Education Council – Task Force on Education and Technology

There is scope for co-ordination of issues between the States and Territories through the Task Force on Education and Technology which has recently been established by the Australian Education Council. It is chaired by the South Australian Minister for

Education and Technology and includes senior representatives from an educational authority or institution in each state and representatives from the Commonwealth Department of Industry and Commerce and the Department of Science and Technology.

Its terms of reference are broad and allow it considerable freedom to explore the multitude of issues involved in the relationship between Education and Technology, with the emphasis being on Education:

1. To develop options for consideration by the Australian Education Council for a strategy of policy and programme initiatives to assist and encourage the Education system from early childhood through to post tertiary, in stimulating, anticipating, shaping and responding adequately to technological change, and an increased level of technological innovation in Australia.

2. The options referred to in Paragraph 1 should be developed in the context of specified objectives in terms of the need to:

a) develop the capacities and skills necessary for individuals to play a productive part in the changing economic and social life of Australia, and adjust to structural change,

b) distribute these capacities and skills more equally than in the past, and

c) take account of the effects of the application of technology on learning processes and achievements, and the quality of human relations both outside and inside the Education system.

3. Both short term and longer term options should be considered and estimates of the costs and cost effectiveness indicated.

4. To report from time to time to the Executive Committee and to report to the AEC at its 50th meeting (October 1985).

The Department of Education and Youth Affairs prepared an issues paper, specifying the following lines of inquiry for the Task Force:

1. Technology and Educational Goals

2. Developing and Application of New Knowledge

3. Technology and Society: Educational Implications

4. Technological Change and Workforce Issues

5. Technology and its Applications in Education

The breadth of the terms of reference reflects the nature of the complex interactions between Education and Technology. Each of the five lines of inquiry specified by the Department of Education and Youth Affairs has been considered within previous inquiries or addressed through policy and discussion documents; yet the pervasive influence of technology on education leaves scope for these issues to be addressed again and again in differing contexts or with differing emphasis.

Universities and research centres

A number of individuals and groups are undertaking research in Education and Technology. The areas of study cover a wide spectrum from the social and educational implications of information technology to specific software and hardware design. Researchers from a range of disciplines are engaging in education and technology studies including investigators from schools of teacher education, centres for behavioural studies in education, mathematics education units, rural management units and colleges of advanced education. A number of projects are outlined here to demonstrate the diversity of interests.

A research, consultancy and training organisation was established in late 1983 at the University of Wollongong. The Centre for Technology and Social Change which sees itself as independent of government, industry, trade unions and pressure groups, aims to provide an informed analysis of the issues and problems associated with contemporary technological developments and to raise the level of educational and technological skills in Australia required to deal with technological change. The centre is promoting debate between Government and academic policy analysis through closed Policy Circle forums. This allows a free interchange of ideas and perspectives on policy issues. Education is not currently a major emphasis of the Centre.

Research being undertaken at the Armidale College of Advanced Education focuses on in-service training particularly in relation to the introduction of computers into primary schools and also

whether various learning theories and learning styles have an impact on software development.

The Department of External and Continuing Education at the Darling Downs Institute of Advanced Education has a number of projects in progress. These include the development of computer managed learning systems to support the instruction of tertiary students and the use of advanced technologies for authoring, checking and producing distance educational materials. The School of Education Centre for Electronic Learning is conducting research on the use of LOGO in developing the cognitive strategies of young children.

Researchers in the Department of Psychology at La Trobe University in Victoria are investigating cognitive development and learning to read. The project develops hardware, software and experimental procedures aimed at supporting and studying the use of computers to help young children learn to read. A longitudinal study is being undertaken to follow the reading skill development of children receiving regular computer assisted instruction for at least two years. The Department of Computer Science at the same institution is examining the use of PROLOG in teaching, and the application of artificial intelligence techniques to computer assisted learning.

The Mathematics Education Unit at the New South Wales Institute of Technology is concerned with the social and educational implications of information technology, in particular the effects on the workforce and hence its effects on the unit as a vocational institution.

The Rural Management Unit at Muresk Agricultural College in Western Australia has undertaken research projects with the aim of introducing farmers and tertiary agricultural college students to microcomputers and evaluating and demonstrating farm management software.

A project is being undertaken at the Department of Continuing Education at the University of New England in New South Wales described as Australian Post-Compulsory Education Policy: A network and ongoing development process, 1980-1990. This brings together a network of concerned citizens who will rethink the purposes and methods of Australian education.

A study of industry training requirements was undertaken by the Department of Technical and Further Education in South Australia. The major purpose of the study was to review current courses in the trade of cabinet making. The study examined the relevance of 'traditional' skills and investigated the need for basic management skills training, the need for personal development education and education in industry requirements and the need to accommodate technological change in the industry. It examined the need for TAFE to monitor technological change in the industry and supported the concept.

A telecommunications co-ordinator has been employed by the four tertiary institutions in Western Australia and the following activities are being undertaken:

> Analysis of communications costs to determine possible savings;
>
> Analysis of the policies of other telecommunications users in the State to determine possible co-ordination.

The University of Western Australia is currently examining the PLATO computer system and research is being undertaken in the Faculty of Education on computer assisted instruction and reading.

The private sector

The involvement of the private sector in education is increasing in Australia and is exerting influence on teacher training and computer awareness education in particular. IBM, for instance, in 1984 launched the IBM Star Wars Education Show which is touring primary and secondary schools in New South Wales. The show includes an exhibition of computers demonstrating robotics, voice synthesis, video control and graphics. It includes a display of 40 IBM personal computers, specially programmed to allow the school-age audience to experiment and find out for themselves how computers work. A third part of the show incorporates a half-hour play featuring popular "Star Wars" characters and addresses computer literacy. In its first year it is hoped the show will reach about 250,000 people. It is hoped by IBM that its project will penetrate further into schools. With the co-operation of state government education bodies and teacher education institutions, IBM Australia has launched a secondary school computer education programme; IBM Australia will

contribute 221 IBM personal computers and software to three states in the $2.5 million programme. The early phases of the programme focus on teacher educators and the teachers themselves. Phase one of the programme began in Sydney in May, 1984. Teacher educators from South Australia, Queensland and New South Wales as well as eight overseas participants from Canada, New Zealand and Malaysia learned how to use the Personal Computer and a range of application software; they also learned how to develop courses for their own use in high schools.

In Phase Two of the programme, the teacher educators plan and conduct in their own states, in-service, professional development programmes for teachers. Three computer laboratories will also be set up in this phase, in each state, each equipped with fifteen personal computers. Teachers trained in these laboratories will be able to return to their schools with their own personal computers to further familiarize themselves in their own time with the potential application of the system. By January 1985, Phase Three, the teachers will be setting up fully equipped computer laboratories in each school and planning computer application projects and will be able to train other teachers in their school. IBM marketing education expected to teach, in 1984, 40,000 student/days, the equivalent of a small university.

Information Technology Education Centres

A new approach to training young people to use technology is currently gaining in popularity in Australia. The Commonwealth Government has committed $5 million over three years for the establishment of Information Technology Education Centres (ITECs), beginning in the 1985 financial year with projects being located in different states. ITECs are British in origin and it is likely that the United Kingdom model will be followed closely. The objectives of the British ITEC programme are:

1. Provide a one year course of training in Information Technology for unemployed school leavers whose academic attainments would preclude them getting such training elsewhere.

2. Develop programmes of training, both technical and non-technical, work experience and counselling so that trainees acquire a practical, marketable skill and have the best possible chance of getting a job at the end of their stay in the ITEC.

3. Encourage the use of the Centre by outside groups and individuals. This open access can provide benefits to both the community and the ITEC Courses, formal and informal, can be run for adults who need some I.T. training e.g. businessmen, teachers and amateur enthusiasts. Conversely engineers and programmers with good ideas but lacking money and equipment can be given facilities to develop their ideas with possible benefit to the ITEC.

4. Promote schemes for job creation.

It is hoped that ITECs will be more successful in forging links between the unemployed and local community than the current commonwealth youth training scheme, known as CYSS, the Community Youth Support Scheme which provides short information courses for unemployed young people. The ITECs will be in a position to provide valuable services, particularly training in Information Technology to the community outside normal ITEC working hours. Services that might be offered include short-term training for businessmen and community groups or a consultancy service to small businesses buying their first microcomputer. Computing services on a small scale could be offered such as word processing, data entry and simple programming. There is scope for ITECs to go into production, marketing hardware or software.

The courses offered through ITECs in the United Kingdom include electronics, hardware maintenance, software applications, computer graphics, view data systems, videotex, technician and operator level courses and word processing. The teaching method is "hands on" which leads to high capital requirements but also contributes to the atmosphere of self-motivation and self teaching. The ITECs, it is hoped, will redress the balance of access to advanced technology. In Australia access to computers within schools is limited for "hands on" experience, so it is typically the more advantaged young people whose parents can afford a personal computer who are gaining the experience. ITECs will make advanced technology available to disadvantaged youth who are to some extent alienated from existing institutions.

Some care will need to be taken in the transfer of the model for ITECs from the United Kingdom to Australia. The community response and service requirements in Australia may well differ greatly; the social organization of communities in Australia differs

from that of Britain in terms of density, community focus and location of industry and small business. The teaching of information technology skills through the "hands on" method to disadvantaged and alienated young people requires special skills which may well differ from the teaching skills required in current vocationally oriented programmes.

Educational courses

In Australia, various general courses are being offered or have been proposed in computing, usually for lower secondary or upper primary students. These are described as computer awareness or computer literacy courses. Computer awareness in the main suggests a need for student awareness of the nature and uses of computers and an understanding of their social effects; computer literacy puts more emphasis on the functional skills people need to operate effectively in a society in which information technology is increasingly significant.

Computer Studies and Information Processing are an elective component in the curriculum and are, according to the Commonwealth Schools Commission report *Teaching, Learning and Computers* growing in importance. Computer Studies and Information Processing most often are studied in the late years of secondary school.

Technical and Further Education (TAFE) has traditionally taught vocational skills and is being increasingly looked to in terms of its shorter applied courses to respond positively to technological change by preparing the workforce for rapidly changing labour requirements. Units which examine technological change have been introduced in tertiary colleges of advanced education which have responsibility in the main for teacher training. The South Australian College of Advanced Education, for instance, offers the following units:

1. Technological Change and the TAFE Teacher – this aims to develop an understanding of the impact of technological change on teaching in adult and further education.

2. Science, Technology and Values – this describes some major scientific and technological achievements and their effects on Australian society. The relationship between technological change and personal/social values is emphasized.

3. Technology, Communication and Society – this aims to develop an understanding of the interaction between technology and society. It examines ways in which current technological innovations may affect future modes of communication in society.

4. Technology and Society – this examines the effects and consequences of the human race's ability to manipulate its environment. Content includes technics, technology, applied science and science; technology and change, technology and values; technology and the future, appropriate technology.

5. History of Technology – this aim to develop an understanding of modern technology through historical study of the subject. It emphasises the impact of technology on the social and economic life of the community.

Institutes of Technology offer a wide range of technical and applied degree courses, for instance Biotechnology, Computer Technology, Computing – this includes a wide range of majors such as Information Processing, Health Computing, Computer Technology, Computer Electronics, Electrical Engineering, and Medical Technology.

Universities offer degree courses in Computer Science, Information Science, Mathematics, and Electronic Engineering which have particular impact on Information Technology but technology impacts on a host of other subjects from primary school through to tertiary level.

Community education

Institutions at each level of the education system have taken some responsibility for community education. At primary level, parent evenings are held at which computer literacy is considered as well as the social impacts of information technology for their children's future. Tertiary institutions, in some cases, have supported the use of computing centres for short vacation courses in the use of microcomputers. Involvement of the community in educational activities is essentially the responsibility of the individual school or institution.

The Department of Science and Technology established Information Technology Week in 1981, a week in which to focus on

technologies and learn about their applications at displays, courses and exhibitions, and a week in which to discuss the social implications and structural change inherent in their introduction at workshops, courses and seminars. In 1984, Information Technology Week was extended to Information Technology Month. A series of five publications examining information technologies and the issues surrounding their introduction has been produced each year since 1980; these are distributed free of charge as a community service.

Community interest in the issues relating to Education and Technology is high. The topic attracts the interest of mathematicians, computer scientists, economists, educationalists, psychologists and sociologists for instance, at one level, and at another it attracts educators, journalists, parents, unions and computer enthusiasts. Newspapers and current affairs magazines are currently a dynamic medium for the discussion of educational and technological issues. Journalists on the larger newspapers and magazines are keeping abreast with computer education issues in particular.

Unfortunately much of the academic discussion of educational technology is ephemeral or of restricted access by virtue of its medium. Papers presented at conferences often remain unpublished or unknown to those for whom the conference falls outside their specific discipline. Discussion papers and policy documents frequently remain in-house. Currently Australia has no central clearinghouse for the collation and dissemination of information concerning Education and Technology. Though there is considerable activity and interest in Australia which spans the five sectors, from community level to Federal Government level, the lack of this central focus renders discussion intrasectional and prohibits cross sectional debate.

Chapter Three

FUTURES AND THE INTERFACE

Futures studies in Australia

The study of futures is an attempt to found forecasting or prediction on a systematic basis, to generate alternative scenarios from the various signs, indications and trends which may foreshadow future circumstances and developments. Its value lies not so much in its predictive capacity, but rather in its usefulness to present policy and decision makers through the projection of alternative contexts in which decisions and policy may be implemented. In Australia, consideration of futures by many commentators focuses less on alternative futures than on the possible or likely impact of technology, or a particular development, on society.

There are, however, isolated initiatives which take an alternative futures approach. The most comprehensive of these has been a 'Futurology' symposium on "Methodologies for Social and Technological Forecasting", held at the Caulfield Institute of Technology in 1979. Whilst taking a particular interest in future studies methodologies, the symposium also considered issues involved in technology and education in this context.

Other symposia and conferences on a wide range of issues have included a futures perspective. For example, a conference was held in February 1984 in Western Australia entitled "Rural Communities: Beyond 1984" which addressed the issues affecting the future of rural communities in the context of technological change and aimed to produce strategies to enable communities to respond positively to proposed developments.

The Commonwealth Government's Commission for the Future, to be established in 1985, is currently the most direct government attempt to address the question of futures in a technological society. It has no specific educational brief, but is likely to see schools as a major issue for discussion. There are some indications, at this early stage, that the Commission may take an approach which develops an

awareness of technology and its impact, rather than promoting the critical analysis and synthesis of ideas, and placing them in the context of alternative futures.

A major planning initiative in Australia was the Australian Telecommunications Commission project "Telecom 2000". This surveyed issues relevant to the long term development of telecommunications in Australia to the year 2000. The report, published in 1975, proposes open planning as a means of matching the development of new services to the needs of society and advocates consultation with the public on planning matters. The theme of planning for the year 2000 has also been taken up by small community groups. Three country towns in Western Australia, for example – Albany, Quairading and Bunbury – have established committees to plan for the future of their communities, examining their futures from both an economic growth and quality of lifestyle perspective.

Much of the commentary on technology education and futures comes from widely different sources. The Commonwealth Department of Education and Youth Affairs, for example, has published a paper entitled *"The Environment for Education to the Year 1990 and 2000"*, emphasizing the view that technological change is not inexorable and that its introduction is a matter of social choices. Other papers produced in 1983 and 1984 have looked at a range of topics which have futures perspectives including those on technology in education, the significance of technological change for the future structure and organization of Australian tertiary education and educational research in a science and technological future. A study which is likely to be of considerable impact has been commissioned by the Western Australian Technology Directorate, and carries the title of "Technology and Society – Partnerships for the Future". An indication of the range of literature available is given in the bibliography appended to this report.

An "Australian" future

Any consideration of futures must take into account the increasing interdependence of nations. In addition to complex and interrelated networks of trade, multinational corporations and international organizations exert increasing political and economic influence on nations and nation-states in particular. As technologies change, power and wealth patterns shift, established values are put

under stress and new national objectives are developed. The aspirations of one society come to affect those of its neighbours and ultimately all segments of the human community.

The increasing ease of international communications allows business to be conducted quickly and efficiently between countries, enhancing trade links and speeding up transactions, even linking previously isolated production areas into the global trade market. In economic terms, the ease of communication between countries to some extent breaks down the traditional relationships with neighbours as new markets become accessible in the global village. Information and communications technology will continue to enhance the exchange between nations of expertise, ideas and culture.

At the same time, communications technology may also serve to alter social attitudes and values by imposing those of a dominant culture on others. A prominent example is that of American and British television programmes, which reflect to some extent the dominant values of the country of origin, and which are exported to many countries. In Australia, many people feel they have a grasp of the American character and culture simply from television programmes. It is important that communications technology, which has the potential to bring cultures together, be not allowed to impose one culture on the global village.

It is in this general context that the question of the direction of the Australian future needs to be considered. Any country may, of course, attempt to develop for itself a dominant role in world or regional affairs. Alternatively, a country may seek a more participative role in terms of joining with others for the equitable development of all nations and peoples. Which role Australia seeks is a matter to be determined by government. Unfortunately, however, concepts of the best possible international community will not necessarily determine the outcome. Trade and defence interests, for example, will continue to play a major role. Variations in respect of these have been visible in Australia as it has become less insular in Asia and the Pacific. But the dominant motif of self-interest remains. Technological development is an example of this in a trade sense, in that the cost of importing high technology is expected to be $A3000 million in 1984-85 and the push is to counteract that economic drain. Short of a major shift in the economic systems which dominate world trade, it seems that national self-interest tempered

perhaps with some concern for the equitable distribution of resources will pervade Australia's interest in technological development and its interface with education in the foreseeable future.

Political and ideological considerations

Futures are also linked to fundamental political ideologies. There is considerable discussion concerning the choices to be made about the acceptance and integration of technology into society, focusing particularly on its effects in human terms. How will the profits of technology be distributed? Will technology increase or decrease the relative equality of groups within society?

In much of the discussion, technology and the future have become almost synonymous. Although there is a widespread feeling that the progress of technology is inexorable, sweeping all before it with people powerless to stop its course, some do emphasize the human choice involved in acceptance of technology, focusing on the need to balance technological development against its costs in human and social terms.

The current Australian climate, in which over 20 per cent of its youth are unemployed has spurred a prevailing ideology that the relationship between economic growth and employment is linear. One assumption made is that an Australian technology industry will create employment and that this will stimulate the economy. Whilst there is an assumption that there will be a "trickle down" effect, that the profits of those directly involved in technology will filter indirectly to other sectors of the community, this is offset by an awareness of inequalities within society. Recent government initiatives have placed an emphasis on the participation of disadvantaged groups such as women, aboriginals, migrants and the disabled in training and retraining programmes. The government's "priority areas on national interest" in 1983 for research and development demonstrate the dual focus on stimulation of the technology based industries and the welfare of disadvantaged groups. The declared interests were:

1. Research and development into products and processes, marketing, trade and social and legal issues concerning high technology areas such as:
    a) energy technology,
    b) information technology,

c) materials technology,
d) biomedical technology,
e) biotechnology, and
f) raw materials processing;

2. Manufacturing technology;

3. Productivity;

4. Income, wealth and social inequality;

5. Social and economic issues affecting training and employment with particular regard to those affecting women and youth;

6. Occupational safety and health;

7. Social and economic implications of ageing;

8. Aboriginal affairs; and

9. Provision of services (e.g. welfare, transport, health care).

Lansbury[1] postulates three alternatives in respect of the balance between economic and social factors inherent in the choices for the future of work:

Scenario A is a "high technology" alternative based on the assumption that employers will increasingly substitute capital for labour in the form of automated or computerised production processes. The unemployed will be assisted by a guaranteed minimum income. This foreshadows a two-tiered society in which a small technocratic elite has access to a limited number of jobs and a majority of people whose relationship to the economy is limited to consumption.

Scenario B is a "low technology" alternative in which the pace of technological change is modified by measures which ensure a high level of demand for labour. Education and training would therefore have to be closely linked to labour market requirements.

Scenario C is a "mixed technology" alternative which tries to be selective in its acceptance of technological change whilst acknowledging that the economy will not be able to provide jobs for

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[1] Lansbury, R.D. 'Structural and institutional barriers to change' in Sackville (ed.) *The Future of Work*, George Allen and Unwin, 1984, p 123

everyone. In this scenario, the Government does not seek to discourage technological development but it ensures profits from this sector are used to support leisure activities.

The choice ultimately involves political ideologies, whether it is more important to focus on economic or human goals, and the priority one is given over the other. In Australia, as elsewhere, a complicating factor is the developing interest in environmental issues. There is a growing concern for the conservation of the country's historical and natural heritage. Lobby groups are increasingly gaining credence in the community and are providing constraints in the political context to the unrestricted growth of industry. This growing concern for the effect on the environment of expanding industry and technology is likely increasingly to influence the character of the economic growth the community will tolerate.

The technological future

An important issue likely to affect the technological future of this country is the extent to which the future will feature Australian technology and, therefore, the extent to which technology will remain under Australian control. Currently Australia imports much of its technological resources. Because of this there are a number of initiatives being taken to stimulate "home-grown" technological development. The emphasis is being placed not so much on the production of low cost technological products in quantity for the existing market, but rather on the development of new products for new markets.

A number of internal political factors will affect the extent to which an Australian technology industry will evolve. The fear of job displacement by technology, for example, affects the community as a whole in a country where income security is directly related to employment. Further, structural employment changes will need to be negotiated to provide some financial security if displacement resulting from technology does occur. In addition, government sponsorship of Australian companies in terms of financial incentives to encourage them to branch into new areas will be required. Currently, no large Australian companies seem interested in laying claim to the technology market and many of Australia's graduates who could contribute to the research and development in this area are being attracted overseas.

An alternative to an Australian technology industry is the acceptance of the dominance of multinational corporations. These corporations now represent a key force in the international business world and a major influence in the conduct of world affairs. Whilst they operate transnationally, multinational corporations may reflect a particular culture and set of values. Australia has experienced considerable multinational involvement in the development of its interests including its fuel and mineral resources. Through diversity of location and operation, these corporations may remain relatively immune to world economic fluctuations. The major debate concerning their operations revolves around the extent to which their internal objectives and priorities coincide with those set by the nations within which they operate. Their considerable influence on the economy and employment of a country raises questions concerning their influence on these nations' political processes, especially when it comes to technological development. They may, for example, have little interest in the development of an indigenous technology industry.

The educational future

To consider alternative futures for education is a complex task. Both education and technology affect and are affected by an array of social, political, economic and environmental trends. Technology is posing fundamental questions concerning the role of the future of education in society. This is leading, in Australia, to a reconsideration of the underlying philosophies of education. On the one hand education may be viewed as a response to economic and material values, to economic growth, to technology, to the labour market. Here education would be expected to contribute to the development of marketable skills, credentialism and the fostering of competition. On the other hand, a person centred society would ask education to have as its priority, human needs, technology in the service of mankind, participation and power sharing. Education would be asked to promote self expression, individualism and quality of lifestyle. In Australia there is currently a questioning – induced at least in part by projected labour market demands – of the value bases of education. Whilst there is generally an assumption that education should assist people in adjusting to new patterns of work and leisure in a new information technology society, there is held to be a role for education in respect of its preparation of students for a vocation.

Technology is ascribed the power of altering the nature of work and a primary function of education is seen to be to respond to this. Whilst the philosophical balance of education is currently under discussion, so too is the means of applying the philosophy. There is no consensus concerning how education should prepare people for a new information technology society or the nature of the skills that will be required. Nor is there agreement as to how to facilitate personal development or increase the quality of life in a rapidly changing society.

Education is expected not only to prepare people for a changing society but also to change society itself. The relationship between society and education is sufficiently close to make it difficult to envisage alternative futures for education without considering alternative futures for a society of which education is a product. As the implications of technology for the structure of work, for economic growth, for the equality of individuals in society and for the broader character of life in the future become apparent, the education system is increasingly subject to demands to prepare students for an uncertain future. The ability of education to meet these demands is becoming increasingly uncertain. The rate of change more than the nature of change is causing particular difficulties.

Formal education systems may respond to the technological future in one of three general ways.

Firstly, the system may ignore technological change and maintain existing educational principles and structures. This raises questions concerning the relevance of the education it will provide not only in terms of preparation for the labour market but in preparation for life in a technological future.

A second response is to adapt existing structures in an attempt to meet technological demands. This raises questions concerning how responsive structures are to significant change, the degree of adaptation required and their ultimate effectiveness in responding to rapid change.

The third response is to change existing structures and to develop new structures with the capacity for flexibility and rapid implementation of changing policy. This may challenge existing systems and prove politically unpopular.

Current initiatives tend towards the second response. Existing structures are being maintained with an overlay of sectors with a technological focus such as computer policy committees, thereby increasing the structural complexity. Technological issues and computer literacy are being added on to existing curricula. Education is playing a sub-technological role, responding through existing structures reactively to technological development.

How appropriate this role of education is depends to a considerable extent on how well educationists perceive technology. There is evidence in Australia to suggest that educationists have a somewhat limited view of technology. Of concern also is the limited liaison between Departments of Education and those related to technology. It is possible to develop a very negative scenario of the future, if education continues to respond to technology within existing structures. For example, the communications gap between technological development and the educational response may well increase. As technology develops and differing labour market skills are required, the demands on the education system to fulfill its requirements may well not be met and the skills produced will be consistently out of step with industry's demands. Students may leave educational institutions to find they do not have skills in the relevant technological areas. The lack of suitably skilled and innovative students in state-of-the-art technology will impede the hoped for stimulation of economic growth through new technology development. The lack of suitably trained students in the labour market will throw considerable responsibility for training and retraining on to industry itself which may choose to import the skills it requires and further disadvantage these young people. The responsibility for general technological training may also fall on institutions which currently provide specific vocational skills. This will, in effect, lengthen the time spent on learning tasks and, therefore, increase the cost of education. It may also have the consequence of increasing student alienation.

This negative scenario is not, of course, inevitable. But its possibility does raise the question of whether the proper pattern is for education to respond to technology, in a reactive way, with merely some adaptation of existing structures.

Chapter Four

INTERFACE ISSUES

The issues which are products of the relationship between Education and Technology cannot be addressed in detail in this study, yet an understanding of their character and diversity is essential to the context of debate in Australia. In July 1984, at the OECD International Conference on Education and New Information Technologies, a paper was presented which examined the overall trends and issues which relate to Education and New Information Technologies; in this chapter we present some of the issues which shape particularly the Australian context. The composite of issues presented here is by no means comprehensive but reflects some of the considerations current in the Australian debate. Issues have been arranged under a number of major headings for convenience, though clearly a degree of overlap occurs. The composite of issues should not be read as a reflection of the complete Australian context, there will certainly be omissions and variation in the significance and topicality between issues.

Policy

Technology and education. Technology raises the issue of the functions of education. Should the function of Education be to respond to economic values and the labour market? Should Education place priority on the individuals needs, focussing on socialization processes such as life skills? What is the balance required between Education for vocational and life skills?

A wide range of perspectives on this issue are current in Australia, raising a number of questions relating to educational values of which the following are examples:

Should educational participation rates be increased with the objective of stimulating economic growth as a result of the higher skills level it may produce?

If technology will alter the nature of work, should Education focus on the vocational skills required in a technological future?

Are low participation rates in the post compulsory years the result of alienation of young people from a school system which is not meeting their needs? If so, should Education focus on life skills?

Will technology produce permanent structural unemployment? If so, should we educate individuals in the meaningful use of leisure time?

Which aspects of technology should be incorporated within the educational system?

a) Should young people be taught how to use technology at the level of operation?

b) Should young people be educated for an awareness of technology, its social impacts and effects on their lifestyle?

c) Should young people be educated in an understanding of technology principles or design?

d) Should Education incorporate a mix of the above and if so, what should be the balance?

What are the policy implications of rapid technological development? For example:

In which aspects of technology should young people be educated, when they are ten years away from the workforce? Will their skills have become obsolete by the time they have finished schooling years?

Will the now new technology itself become invisible in the way we have seen the once new electricity become so? If so, what are the implications for educational policy on technology education?

Technology and employment. What will be the impact of technology on the labour market? What are the implication for educational policy? For instance:

Will growth occur at the higher occupational skills level or will it occur in unskilled occupational areas? Will technology increase or decrease with skill requirements of the labour force? How should Education respond to labour market requirements?

Should Educational policy attempt to meet labour market demands by teaching specific vocational skills or should policy

provide a general education and encourage the provision of vocational training after the compulsory schooling years? What constitutes a general Education? How can labour market demands be forecast?

Will technology displace jobs? Should the Education system be preparing people to cope with unemployment?

Research and development. What are the implications of technology for Research and Development policy.

Should funding priorities favour pure or applied research? Of the many arguments, some maintain that applied research should receive priority as it may provide a direct stimulus to economic growth; others argue that many pure research questions remain unanswered and these form the basis for applied research.

Is further research required into fundamental educational and technological issues? Is technology being used in educational processes without a thorough analysis of, for example, its optimum potential or social impacts?

Should private sector sponsorship and collaboration with tertiary institutions be encouraged? What are the implications for the resourcing of tertiary institutions? What are the implications of private sector involvement on the determination of research trends? How much control should the private sector be allowed over, for instance, research directions, research findings and their publication?

Can the economy be stimulated through resourcing research and development? If so, are academic institutions the most appropriate structures for applied research?

Are graduates able to find employment in this country in areas of technological expertise? Does Government purchasing policy stimulate the growth of local technology industry? What are the implications of multinational corporation involvement in research and development to graduate opportunities in technological areas in Australia? Are multinational corporations likely to open research bases in Australia? Where will graduates with technological skills be able to find employment?

Special interest groups. A wide range of groups have a particular interest in issues relating to Technology and Education and may be in a position to influence educational policy.

How will educational policies affect union interests?

How will policy affect community groups? These range from locally based Parent and Citizen Groups to professional associations for educators such as the Australian College of Education to organisations which comprise representatives from institutions such as the Australian Council of State School Organisations. These groups similarly must be considered within policy decisions. Parents and citizens groups for instance have been instrumental in a number of educational policy decisions and in the past have had a particular interest in the introduction of computers into schools. How may community groups affect policy?

A quarter of Australia's children and young people attend non-government schools. How can policy issues be effectively negotiated with the independent schools? How may liaison mechanisms be established for national programmes?

What will be the implications of policy to the private sector? How may the private sector influence policy?

Cost effectiveness. What are the implications of technology for the cost effectiveness of Education? For example:

How may the educational value of a particular technological development or programme be balanced against the financial cost? A new device may dramatically improve the quality of a distance education service but double the cost of education per student, demanding a judgment of its actual cost effectiveness.

Should technology be seen as an adjunct to Education or as an alternative to Education? Computer technology, may be used to supplement existing teacher methods or may become the teacher itself. What is the cost-effectiveness balance in educational and financial terms? What are the hidden costs of using technology as an adjunct to traditional schooling, for instance in the cost of teacher training?

What is the long term cost effectiveness of using technology in schools? Will computers become cheaper in the future or will the price remain the same with an increase in sophistication of the equipment? What is the life span of particular technology; how long will it take before it becomes obsolete?

What is the optimum ratio of student to computers to ensure a cost effective use of technology, balancing cost against educational benefit?

System

Structures. What are the most appropriate structures for technology education? Intensive short courses relating to technology are available through a variety of media including University Extension courses and evening classes. Some television channels currently screen educational programmes at non-peak hours. Should these informal means be enhanced to take responsibility for updating technology skills, for example, or adult computer education?

The value of community educational resources is currently an issue in a climate in which a need is expressed for developing community awareness. Community resources may include high technology parks, computer fairs, technology museums and information technology weeks. What is their value in promoting awareness of technology? Are the educational principles subsumed by private sector marketing principles?

The potential of Information Technology Education Centres is currently under discussion. Should they be introduced into Australian communities? What is their educational value? Are educators available who have both an understanding of the technology to be used and the ability to work with the disadvantaged target populations? How cost effective would they be? Who should control or manage the centres?

Can Technical and Further Education (TAFE) provide a more flexible and responsive system for technological change than the primary and secondary school systems? If TAFE should play an enhanced role in technology education, where will funding come from for increased staffing levels, staff development and expansion of existing facilities?

Does the private sector have the potential to form an alternative education system? Are technologists more appropriate to teach technology and general education than educationalists?

Are completely new structures required for education in a technological future? If so, what should the structures be?

Distance and external education. What are the implications of communications technology to distance and external education.

What are the effects of new technology on student learning? Trials have been undertaken using a variety of technologies including subcarrier radio tutorials for external students at tertiary institutions and on-line use of computers for isolated secondary students. The implications for student participation, motivation and progress are examples of issues these developments raise.

To what extent does the medium used alter the form or content of the normal curriculum and to what extent does the system improve or impede teacher-student interaction?

How realistic is it to consider ongoing use of the technology? In the case of computers, for instance, is it justifiable to provide each isolated student with a personal computer? What are the sources of funding for successful trials and how isolated either geographically or by social circumstances should students be to merit the expensive technology that is available?

Structural relationships. What are the implications of technology on educational structural relationships?

The relationships between Education and Technology planning at Government level are an issue. The policies developed concerning technology affect education and likewise those developed concerning education will affect technology. It is interesting to note that the portfolios for Technology and Education are shared by one Minister in South Australia. At Federal level, the Technology portfolio has recently been separated from Science and a new portfolio developed, Technology, Industry and Commerce.

Federal-State relationships likewise raise a number of issues. Federal technology and education policy and resourcing passes from Federal to State level. How effective are Federal-State liaison methods in relation to national policy programmes?

How effective are links between State Governments to ensure uniform educational directions within Australia? Should, for instance, national co-ordination programmes be implemented in computer education to ensure interstate compatibility of software and hardware? Should the states be allowed to follow their own directions to meet state objectives or should they attempt to meet

national educational objectives? What are the implications of each option?

How effective are the links between different educational sectors, for instance between primary and secondary schooling and between secondary schooling and TAFE or tertiary institutions? Is continuity of technology education being maintained? Is division of responsibility between the levels for technology education desirable and feasible? Is duplication of services and resources occurring across the sectoral levels and within the sectors?

Are the links between special interest groups, such as industry, parent and citizen groups and unions adequate? Are their requirements being monitored constantly and responsively? At which levels of Education policy development, administration and service delivery should special interest groups be involved?

Curriculum and technological resources

Technology education. The following curriculum and resource issues arise as a result of technology education.

Should technology and technological issues be integrated into the curriculum within existing subjects, for instance discussing its social impact in social studies or incorporating computer literacy within mathematics or science, or should it remain a discrete subject? If computer studies or computer literacy is compulsory within a school system what are the underlying assumptions of this and what if anything must be sacrificed to make way for it?

Given that technology covers so many new developments, which should be considered within the curriculum? What is the relative importance between communications technology, information technology and appropriate technology? Which technology skills are required at each level of education? Should we be teaching computer programming or computer operation, both or neither at primary and secondary levels? Should we be educating people *about* technology, its social effects and implications or should we be teaching *through* technology, the skills required to make use of it, or lastly should we educate *in* technology, design and applications?

Clearly the answers to the above questions will have far reaching implications on policy and system issues such as teacher training, funding and technology resourcing.

Educational hardware and software. The following issues relate to the development and use of educational hardware and software.

Should hardware and software be the responsibility of technologists? If so, what are the implications in terms of adherence to educational principles? If design is the responsibility of educators, how will they acquire the skills to achieve this and who should supply financial resourcing and equipment? If they should work together, what mechanisms are appropriate for co-operation and resourcing the process? If it is preferable for hardware and software to be designed by individuals with experience in both technology and education, how may this be achieved?

What form and content should software and hardware take? What are the learning theories which must be taken into consideration? Who should take responsibility for quality control of educational software? What are the cultural implications of imported software? How does the medium affect the information to be transmitted?

Questions are currently being asked concerning the availability of educational software. Who should be responsible for identifying software needs and current adequacy? If current software is inadequate, how can adequate production be financed and stimulated?

Co-ordination. Co-ordination of computer technology in schools presents the following issues.

The diversity of hardware and software available may lead to difficulties with compatibility of computer resources between schools and between states. Similarly, software may be produced which is compatible for only one kind of computer and may restrict the shared use of educational resources. Conversely, diversity may be seen positively, providing a wider choice of available products which may fulfil a wider range of educational needs. Should, therefore, diversity be applauded or deplored and what are the implications for educational purchasing policy?

If co-ordination of hardware and software between the states is desirable, what is the most effective means of achieving this? Is the National Computers in Schools Programme functioning adequately in this regard?

Should schools choose to use a mainframe computer with separate terminals or opt for personal computers? What are the advantages of each in terms of cost-effectiveness, access to information and ease of operation? Likewise should schools look to sharing information data bases intra-state and inter-state or remain as discrete information banks?

Learning

A number of arguments are current concerning technology and effects on learning.

Learning theory. The introduction of computers into schools raises a number of issues relating to learning theory. If computers are introduced into each subject area as a teaching medium, then some feel, this makes assumptions concerning their usefulness as tools for instruction. As yet, it is stated, the issues concerning their effectiveness and desirability as teaching aids are unresolved and automatic introduction of computer assisted instruction into all areas of the curriculum has not been proven to be more or less effective than conventional teaching methods.

Learning medium. How does the medium, for instance software, affect the quality of the information to be imparted? Does the software accord with current societal values; for instance is it free from sexist or racist implications? Does the medium censor information in the sense that content may be omitted from the curriculum if it does not lend itself readily to software format? Is the software adequate for teaching purposes and, if not, should it be used at all? What are the implications to software development of artificial intelligence?

Cognitive processes. There is considerable debate concerning the cognitive processes computers encourage, of which the following questions provide some indication. Do computers promote problem solving techniques? Do students programme computers or does the computer programme the students? Do computers stifle creative thinking and individuality? The actual computer languages used in schools are also a cause of controversy; debate concerns the relative merits of Basic, Logo, and Pascal in particular. A distinction is drawn between the relative merits of languages which require logical and sequential steps in programming thought and languages which

require a conceptual grasp of the nature of the problem and its solution before programming occurs.

Some question whether we really understand cognitive processes and learning behaviour in general and therefore whether we are able to judge definitively the effects of computers on learning without further research.

Questions are current concerning the student response to computers. Some studies claim an increase in student motivation, particularly those who are low achievers with conventional teaching styles. The long term motivational effects others claim, are as yet uncertain and opinions differ on the achievement in terms of problem solving and cognitive abilities.

Skill development. Concern is current regarding the effect of computers on basic skills, in particular social, numeracy and literacy skills. The effects of word processing, for instance, using a spelling or grammar checking programme on literacy skills is being debated. Similarly, some express concern that interaction with the computer may significantly reduce the degree of human interaction in the classroom and therefore lessen the opportunities for developing social skills.

Access

The access of certain populations to technology and technology education, particularly disadvantaged groups raises the following issues:

Participation. There is some fear in Australia, that with high youth unemployment, young women and young men feel the current education is not relevant to the world they will be entering when they leave school. This is expressed particularly in relation to disadvantaged groups such as Aboriginals, girls and migrants. In order to avoid alienating these groups further from the Education system, some feel special initiatives are required in technology education to ensure opportunities for their participation.

Income security for young people is seen by some as an educational concern. Should financial incentives be used to encourage young people to continue their education or enter retraining programmes? What should be the form and content of programmes to

ensure they are attractive to young people and where should they be located? Should training programmes which upgrade skills take the form of, for instance, subsidized apprenticeships, vocational courses through TAFE or perhaps industry should be encouraged to shoulder more responsibility for training?

Computer access. The access students have to computers raises the following questions.

The need for computer education of any kind in schools has been questioned. The assumptions behind computer education, it is suggested, are that students will have considerable contact with computers in both their work and home life in the future. The degree to which computers will be used in everyday work and home life has been challenged and a suggestion made that computer skills may be learned from sources other than school; on the job for instance, through computer user groups or through informal short courses. It is, therefore, argued by some that students do not require more than minimal access within the school system.

Some studies have shown that, currently, prime use of computers in schools is made by above average advantaged students. There is concern that disadvantaged groups, in particular girls, are not making use of computing facilities. This raises a number of issues including:

i) Location of hardware: If computers are held in a central open facility such as the school library and free access is allowed, boys may use the facility more than girls.

ii) Software content: It is suggested that software, particularly computer games, may use traditionally 'male' themes such as war games, male dominated sports and that adventure games use predominantly male characters and may reinforce sex role stereotypes.

iii) Curriculum area: If computers are used primarily in mathematics and science subjects, fewer girls may have access as their participtionrate in these subjects is lower than for boys.

iv) Classroom dynamics: If students work in small groups of four or five students to a computer, in mixed groups boys

may spend more time operating the machine. A need for further research on the effects of introducing computers into the classroom or work environment is noted.

Should preferential access therefore be granted to disadvantaged students?

Community access. There is considerable debate concerning the most effective means of providing community access to technology, in particular, computers. Should this be through short informal courses, for instance, through existing institutions such as colleges of advanced education and universities or should schools open their facilities to the community? Some would argue in favour of community computer education centres.

There is concern that advantaged members of the community are also those who will have greatest access to community resources and there is a call in some quarters for community awareness programmes to raise awareness of the facilities available and the location of education centres in suburbs where the disadvantaged groups will have most ready access.

Access to Education. Communications technology has implications for access to Education by isolated students, both those who are geographically isolated and those who are socially isolated and unable to attend formal institutions. In the longer term, however, it has been suggested that improved communication techniques may have the potential to free education of both structured time and place, providing open access to many students.

Teacher roles

The impact of technology on education poses many questions which concern teacher roles and teacher training. Many of the issues from preceding sections have implications for teaching.

Teacher/student interaction. The degree to which a teacher is able to interact with students in the classroom when computer assisted instruction is used is a matter under discussion. Some believe it enhances individual student contact, others believe it may impede this contact but may enhance inter-student problem solving. A second issue concerns the degree to which teachers are able to monitor the progress of individual students who use a computer for

part of their study. This clearly raises hardware and software issues as software has the capacity to tailor instruction to the degree of progress of the student. What are the advantages and disadvantages of this type of software to both teaching and learning?

There is some concern regarding the interaction of students with each other; a concern that students, particularly low achievers, may find it easy to withdraw from social contact with other students and the teacher in favour of computer contact. Others argue computers enhance inter-student problem solving. What are the teaching implications of computer dynamics?

Teaching and the use of computers. Given some resource limitations, what is the most effective use of computers in the classroom? Computers may be used as a kind of electronic blackboard to demonstrate a point or be used for drill and practice to reinforce learning points. They may also be used for problems solving or the introduction of new learning points. What is the relative value of each method within each subject area? Which method makes most effective use of the resources available in schools? Is the computer even appropriate in each subject area? Is teacher training taking into account the alternative uses of computers for instruction?

Teaching styles. If students have access either as individuals or groups to computers, what are the implications for existing teaching styles? Should computer literacy teaching, for example, be facilitative or instructional? Is teacher training taking into account alternative teaching styles?

In-service and pre-service training. The following issues are examples of some of the questions concerning teacher training which arise as a result of technological development.

Should priority be given to primary teachers, secondary teachers, or TAFE teachers? Should the training of community educators be a priority? Which sector will take responsibility for each aspect of technology education and therefore which sector should receive the appropriate training input?

Should technology and its educational implications be a compulsory part of the pre-service training of teachers in every educational sector? Should it be particular teachers within institutions who receive in-service training, such as mathematics and science teachers in schools?

Who should conduct in-service training? A wide range of options are available. Should it be the responsibility of computer education centres attached to the education departments or should individual teachers in each school be trained as trainers of their colleagues? Should those who provide in-service training have a background in Education, Technology or both? Should the private sector be allowed to sponsor teacher in-service training and if so, what are the implications to Education? What structures are required to ensure ongoing in-service training? As technology changes and improves, how can teachers update their skills?

The content of teacher training in relation to Education raises a wide range of issues, for instance:

What should be the content and duration of training for teachers at each level of the education system and for each subject area? Who should be trained in computer literacy and who should understand computer programming? Should some teachers in schools be trained in software design, if so, which teachers? Should all teachers be in-serviced in evaluation of software?

What should be priorities in teacher training and staff development? The following are examples of issues that relate to a determination of teacher training priorities. Will the training of only limited numbers of teachers in limited areas provide an adequate educational response to technological change? If large numbers of teachers are to be in-serviced, will this provide a strain on relief teaching? Should financial or promotional incentives be given to encourage teachers to undertake in-service training?

Chapter Five

CONCLUDING COMMENT

When an overview is taken of the developments in the education-technology interface in Australia surveyed in chapter two, the prospects of alternative futures considered in chapter three, and the issues identified in chapter four, a number of general comments can be made, and they are used to conclude this report.

i) The questions and issues raised by a consideration of the interface between technology and education are both very many in number, and very varied in nature. That is, the matter is multifaceted and multidimensional, can be looked at from several different perspectives, and involves many different aspects and components of the social, political, economic and educational systems. It follows from this that a full consideration of the interface needs to be interdisciplinary in its orientation.

In this connection, two features of the debate and discussion about technology and education in Australia seem clear. The first is that the whole question has now moved, perhaps for the first time, to centre stage. Although it has existed as a problem for a much longer time, its move to centre stage is a recent development. The discussion is therefore lively and topical, and many different people and organizations have something to say about it.

The second is that, despite its recent emergence, the discussion and debate seem presently to be in a state of stagnation, and characterized by a lack of progress. The same issues are raised over and over in different forms and different contexts, but there seems little move towards ordering and integrating them. The result is a certain ad hoc, non-cumulative quality to the debate. There exists a series of partial viewpoints, selectively presented depending on the perception of the individual or organization. There does not exist a common perspective or framework

for viewing the education-technology interface, and its many interrelated issues.

ii) The dominant impression from the work on this project – noted several times in earlier chapters – is that the education system is in a reactive role regarding technology and technological development. That is, the education system, at all levels, primarily responds to technology – not only in terms of technological development, but also, it seems, in terms of policy matters regarding the interface between education and technology. The extent to which this state of affairs is desirable is a matter which should be carefully considered. Clearly developments in technology will proceed outside of and independent of, the educational system. But, in many respects, education could take a more positive, future oriented and proactive role regarding technology, both with respect to education for technology and technology for education. If this does not happen, one consequence is that the education system will continue to be pushed and pulled, in an ad hoc fashion, in its responses to technological development. Another is that much education for and about technology will go on outside the formal education system. This too may not necessarily be undesirable, but it is a question which deserves examination.

iii) The title for this commissioned research was "A Study on the Interface between Education and Technology, in the Context of Alternative Futures". A useful dictionary definition of interface includes the ideas of "common boundary or meeting point between areas", and "a general term to describe the connecting links between two systems". The question then arises as to how much of an interface there actually is between education and technology, in the case of Australia. It is tempting to conclude that there is no real interface at present in Australia, or at least much less than there could be. Certainly the weight of evidence we have been able to review supports the view that there could be a very much more pronounced education-technology interface. At the same time, the previously noted level of concern with the topic at this time in

Australia suggests a general desire to increase and strengthen the interface. This in turn points to at least three needs. The first is to develop an awareness of the need for a greater degree of interface. This process is clearly under way, as indicated by the various conferences, working parties, reports and so on, referred to in chapter two of this report. The second is to promote a consideration of which structural arrangements best enhance – and ultimately reflect – an increased interface. It is not, as is often claimed, simply a matter of making centralized educational structures in Australia more flexible and responsive to the needs and developments of a technological society. That may be part of the question. But it is also, and much more, a matter of designing structural arrangements both within and between organizations and institutions, and between the educational and technological systems generally, that reflect the desire and need for increased two-way interaction between education and technology, and that enhance the possibility of that interaction. The third is to recognize the importance of developing a perception of the present and possible education-technology interface, which is common, or at least largely common, to the various interested parties. As noted, the number and variety of general and specific issues involved here strongly emphasizes the need for a common conceptual framework, or model, or viewing the matter. Once such a need is recognized, ways of meeting that need can be organized.

iv) Mechanisims for policy formation regarding the interface between education and technology reflect the issues about structural arrangements for education and technology raised in point (iii) above. At this stage policy formation in Australia seems a somewhat unsystematic process, occurring without an organized consideration of alternative future paths. While there is, as noted, lively debate and discussion, there has not yet been a concerted and comprehensive consideration of policy issues. At the same time, developments are occurring which have important implications for the future. Many examples of this could be given. But a commonly expressed one concerns the

direction and degree of "technological literacy" of the generation of children presently in schools. With microcomputers and electronic games now commonplace, children are learning something about technology. But careful thought is required to determine what the appropriate experiences in schools should be, and here, as elsewhere, the obvious response may not be the most appropriate. It is now becoming clear, for example, that teaching children computer programming in schools may be dysfunctional for their future involvement with technology. Such questions require both careful analysis and a consideration of the future, and have important policy implications for many different aspects of education.

v) A significant volume of material on education and technology now exists in Australia and more will undoubtedly appear. It is important that it be continuously brought together, integrated and evaluated. There is at present no facility for this to be done, a point which became clear when this project began. What is needed, therefore, is a national clearing house for information on the education-technology interface, with the functions of assembling, co-ordinating and evaluating the relevant material, as it appears. Such a clearing house could subsequently become international, at least on a regional basis with respect to Southeast Asia and the Pacific. If located in a tertiary institution, it could also provide the foundation for a research and study centre into the whole question of technology, education and the future. Immediate tasks for such a centre would include taking a leading role in the development of an overall conceptual framework for viewing the education-technology interface, and conducting research into the sorts of questions raised in points in chapter four of this report.

AEC Task Force on Education and Technology *Issues Before the Task Force,* October 1984.

Five lines of inquiry are identified: Technology and educational goals; developing and applying new knowledge; technology and society – educational implications; technological change and work force issues and technology and its applications in education.

Anderson, Jonathan & Downes, Toni *Computers and Education in the Asian Pacific Region.* Report of the Third Asian Seminar on Educational Technology, sponsored by UNESCO. Tokyo, Japan : September 25 – October 2 1984.

A survey of issues and problems identified by a need to integrate computer awareness and proficiency into education. The relationship between computer awareness and future economic growth is stressed.

Anderson, J. Computing in schools: An Australian perspective. In *Australian Education Review,* No. 21, ACER, 1984.

This book covers the impact of microcomputers, predominant overseas models and influences, and examines schools computing in Australia. The different languages of microcomputers are discussed and the specific uses of computers in schools presented. The book concludes with some case studies and a chapter on emerging issues. The sudden rise to prominence of the microcomputer in Australia is traced and many of the most commonly asked questions about computing are answered in simple and direct ways. A coverage of what is happening in and what is affecting computing in Australia.

Arcus, G.R. (ed.) *The Future of Rural Communities.* A report of the conference "Rural communities: Beyond 1984", held in February 1984. RYMC Publication : 1984

Fifty West Australians came together for a two day conference to:

(a) identify the issues affecting rural communities;

(b) identify responses to meet the needs of communities as a result of the issues identified;

(c) plan strategies for the future of rural communities.

Participants were from a wide range of backgrounds – Education, Agriculture, Health, community groups, etc.

The report discusses the impact of new technologies on Agriculture and hence employment.

ASTEC Technological Change Committee *Technological Change and Employment.* A report to the Prime Minister, June 1983. For details, see Chapter 2.

A Technology Strategy for South Australia. Draft for Pariamentary Debate : April 12 1984.

- The Government places importance on close integration of Education and Technology;
- Education must concern itself with the development of a general knowledge of technology and of the necessary life skills to handle change that is rapid and of which technology is a significant cause and component.
- Develop a higher level of self starting and entrepreneurial skills than at present.

Ausburn, L., Ausburn, L. & Hedburg, J. *New Uses of High Technology in Tertiary Education.* AARE Annual Conference, Perth: 1984

Reports on developments of combining video technology with microcomputers to develop an interactive video disc. How best to utilize this extremely powerful technology is a major consideration for all sectors of education – dependent on availability of software.

Drill and practice have been primary uses but there is a shift to simulation and problem solving as well as a higher level of information processing, data management and generally more sophistication than 'electronic tutors'. Examples are given in the paper; implications and applicability for distance education are expounded.

Australian College of Education *The Human Face of Technological Change.* Australian College of Education, Silver Jubilee Conference, Canberra : May 1984.

The subthemes of the conference were: The brave new world of 1984; The Communications Revolution; Being Human in a Techno-

logical age; and Implications of the Technological Society for Education.

Australian Teachers Federation Policy Section B – *Curriculum and New Technology*, pp. 81-88, as endorsed at the Australian Teachers' Federation Conference, 1984.

This section of ATF policy outlines the general principles, perceived role and issues of technology in schools – especially with respect to new information technologies.

Postive and negative learning features are discussed, a call for technological awareness is made and the role of technology in school administration examined. With regards to hardware, "ATF believes that for the time being at least, individual schools should make the final choice about the types of hardware suitable to their educational and administrative needs". However, to balance market forces, ATF believes the various departments should mount displays and forward information on various hardware units and software packages: "To date the overwhelming balance of control of the use of new technologies in education has resided outside the schools themselves."

The policy states: "Control of programme development, files, programmes and other software, and hardware acquisition; must be solidly located at the school level." It proposes setting up 'elected' school curriculum/technology committees responsible for file and programme development to the school; a large group of curriculum developers appointed by schools (and organised on an area, regional or cluster basis), election of "strong representation" from practicing teachers, teacher unions, parent organizations and students; and "state/commonwealth committees with similar representation to service the needs of schools as stated by schools".

There is a section on the conditions required for 'Professional Development' for teachers, and the need for different types of support services – consultants, display centres and forums for debate. The policy suggests evaluation should be the responsibility of the school systems, in the sense that they should encourage evaluation, publicize fundings, etc.; the Federal and State Governments are to ensure there are 'adequate programmes of on-going evaluation'.

With regard to funding, "the Federal Government must be prepared to fund as necessary the acquisition by schools, with regard to sound

educational principles, the most advanced computer and computer related technology to reshape their curriculum. The Schools Commission, or a Commonwealth Committee, representative of teachers, parents and students must draw up educational guidelines for the acquisition and use of these technologies". The mechanism for the dispersal of the money would be a representative State Committee which would evaluate submissions from individual schools according to the guidelines."

Australian Telecommunications Commission *Telecom 2000* (December 1975) and *Outcomes from the Telecom 2000 Report* (July 1978). National Telecommunications Branch, Telecom Australia.

The National Telecommunications Planning Branch operates as a multidisciplinary team within Telecom Australia, conducting research into long range telecommunications policy.

Telecom 2000 is a report which surveys issues relevant to the long term development of telecommunications in Australia. The report proposed open planning as a means of matching the development of new services to the needs of society. ". . . the responses confirm that the need is growing for some form of consultation with the public on planning matters." Some respondents ". . . claimed that Telecom Australia was too closed, paternalistic, bureaucratically rigid and technically oriented to allow any outside interference in decision making. Others were cautiously optimistic.

A predominant theme among the responses was concern over the social effects of future services. "The feeling seems to be fairly common that the application of more technology is not the way to solve problems either in the business world or in society" (p. 12). It was repeatedly claimed that the development of the computing industry is being unnecessarily hampered by policies relating to terminals and leased lines.

Barrett, J. *The Report of an Evaluation of FM Radio Subcarrier Tutorials.* ESTR, Murdoch University, W.A. : June 1984.

This is the report of a project undertaken by the Educational Services and Teaching Resources Unit at Murdoch University to assess the value of tutorials narrowcast through radio station 6UVS FM to a pilot group of metropolitan external students enrolled at Murdoch University and the University of Western Australia.

External enrollees have traditionally used written and tape recorded materials and have been unable to attend face to face tutorials. Supplementary Monophone Transmission (SMT) allows the use of existing broadcast transmitters to send a second programme along with the main FM programme. Telephone feedback to the University studio allows for two-way communication between tutor and students.

Tutorials aimed to reduce the feeling of isolation and to enable students to raise problems encountered in the course materials or assignments. Students and tutors were highly satisfied with the FM subcarrier tutorials. Students participation was somewhat higher than in face to face tutorials.

Burke, Gerald *The Structure and Finance of Education.* US-Australian Joint Seminar on 'The Future Impact on Technology on Work and Education', Monash University, Melbourne: 1984.

"The Federal Government's main priorities are: (1) greater opportunity for disadvantaged groups and (2) meeting the needs of the economy in a period of technological and structural change. The needs of the economy are seen to be served by the expansion of participation, particularly in post-secondary education in courses related to science, technologies and management and also by higher education directly contributing to the revitalization of industry, through research and collaboration with the private sector."

"The national priorities do not give significant attention to education as an end in itself as the maintenance and development of culture, including an understanding of the changing structure of the economy: 'The increasing rates of participation at school now occurring together with a temporarily growing late teenage population are leading to greater demand for post-secondary education'. The federal government is reluctant to fund this increased demand and is seeking ways to reduce the cost of the places it does provide".

"Commonwealth policies on the nature of education levels and fields of study and type of curriculum appear to be based too heavily on *asserted* relationships between education and employment in a period of technological change" – perhaps for electoral reasons.

Campbell, R. *An Investigation of Educational Television as a Teaching and Learning Medium.* NSW Department of TAFE, 1981. (M/fiche No. 98)

This paper is a review and synthesis of the literature. It provides a brief history of the research on educational television, examines the use of educational television as a teaching aid (the role of the tutor/teacher; film vs television; the special contribution of educational television; and pitfalls for the unwary) and describes the aspects involved in making an educational television production.

Christenson, J.E. *Curriculum for a Future with Permanent Technological Unemployment.* AARE Annual Conference, Perth : 1984.

This paper addresses the question of what curriculum would be appropriate for a society in which technological unemployment has become one of its permanent features. It identifies some of the curricula which might be proposed for a society with permanent technological unemployment and attempts an evaluation as to the suitability of those curricula.

Curriculum proposals for societies with time on their hands divide into three major categories: curriculum for idleness, curriculum for production, and curriculum for humanness. It concludes "only curriculum for humanness is worthy of human beings who have been freed from the toil of wage for labour".

Clayman, Linda *Technological Change : Its Implications for TAFE.* Background paper for seminar for senior school personnel of the NSW Department of TAFE, 1981.

The intention of this paper is to outline what are seen as common problems in the TAFE system. "Changes in materials, methods or processes of production or provision of services all fall within the area of changes in technology." The Myers Committee Report on technological change identified the major technological thought to be of relevance as: microelectronic, information, biological, new material and energy technologies and robots.

Features of technological change in the 1970s and onwards: (1) rapidity and increased sophistication; (2) effects on the nature of job functions; (3) changes in the work flow; (4) the kind of staff required by industry (and their training). "One of the most striking features of present and future technological change is that, in most cases, it acknowledges no traditional school or disciplinary boundaries." Some perceived needs within TAFE in responding to the changing needs of industry and students: more interdisciplinary

courses; flexible course structures; efficient use of expertise in school system; adequate facilities and equipment (and access); the need for an overall planning approach to consider means of localising course segments that require high cost equipment and plant at special centres; consideration of obsolescence; investigation and development of a formalized system for teacher updating; streamlining departmental procedures to allow swift response in course and equipment provision; suitable assessment techniques that fit a mastery concept.

Coleman, M. & Joseph, R. *Technology's Challenge to Education : A Role for Industry.* Paper presented at the Conference on Work, Income and Leisure in the Years Ahead, University of Wollongong : September 1984.

This paper argues that economic and social changes occurring in Australia demand that the nation develops a more educated and technologically aware workforce. However, considering the general attitude of industry towards education and training, there is a need for a reassessment of the roles of educational institutions and industry. This paper puts forward a number of reasons why industry should become more involved with workforce training.

Commonwealth Department of Education and Youth Affairs *The Environment for Education to the Year 1990 and 2000,* October 1984.

This paper attempts to identify the key features of the possible economic and social environment to the years 1990 and 2000; to develop a basis for informed judgment about the future context in which the Education system may be operating.

The paper challenges the view that technology is immutable : rather, both the design of new technology and the manner of its introduction are matters of social choice. Further, because technological change raises such fundamental issues as the distribution of wealth and power, equity in society, and numerous issues involving social values and priorities, it must be subject to social control. This raises the problem of who decides?

Commonwealth Schools Commission *Teaching Learning and Computers.* Report of the National Advisory Committee on Computers in Schools, 1983. And *Teaching Learning and Computers: 1984 Information Kit,* May 1984. For details, see Chapter 2.

Commonwealth/State Advisory Committee on the Educational Use of Communications Technology (ACEUCT) *Educational Use of the Australian Communications Satellite System.* Discussion paper, Canberra : 1984.

The Committee reaffirms a fundamental point: that it is essential to ensure that the satellite, like any other form of communication technology, is used to serve sound educational purposes and that satellite uses are cost effective in terms of the alternative methods available to education authorities and institutions to provide similar services.

There are many potential educational uses and contexts: broadcast direct to schools and correspondence students; point to point application (between head and regional offices); interactive applications (e.g. school of the air, counselling, conferencing, CAI etc.).

Possible educational uses of satellite communications: improvements in quality and reliability of communication; enhanced services for distance education; links between schools and data bases; student to student contact (in tutorial context) for external students; campus linking for lesson exchanges; fieldwork or laboratory testing opportunities; combination (with print, and communication) courses for those outside the scope of post-compulsory education (e.g. TAFE).

The educational uses and applications possible will be diverse and will be more apparent as people become aware firstly of using the new technology as an alternative means of delivering existing services and secondly as a means of achieving new educational goals. Details of the present state of preparedness of state education authorities to make use of the satellite are included, together with action required to improve that preparedness.

Connors, L. Untitled article in *Education News,* 1984, II.

This article argues that computers will not make schools obsolete, on the contrary they are gaining in importance as demands are made upon them from an increasing number of sectors. It is argued that the form of technology affecting schools most is the technology of contraception with its effects on the family and family dynamics.

Cook, John *Children Information and New Technologies.* Paper presented at Annual Conference of the Library Association of Australia : August 22-26 1982.

Technological change is affecting all our lives. Many children have access to microprocessors – as well as TV. Maybe children cope with it better than adults. "Television has emerged as the dominant experience in the life of the average Australian child, monopolising more of his or her time than any other single activity apart from sleep."

Cumming, G. *Helping Education Meet New Demands : The Computer as Teaching Tool.* Paper presented to Section 33 (Communication) of the ANZAAS Jubiled Congress, Adelaide : May 1980.

This paper discusses CAI in reading: studies suggest CAI can give educational gains which are substantial, which generalise and are persistent. Calls for the need to recognize the potential of computers in education and the need for R & D ranging from fundamental research through to curriculum development and applied work adapting overseas developments for local use.

Prospects for improving educational effectiveness are now better than ever; many of the most promising possible developments rely on using the computer as a teaching tool. One that is well developed, supplementary computer-assisted instruction in basic skills is described and other uses are sketched.

Cumming, G. *PROLOG : Using Logic Programming in Education.* Off-campus materials for Deakin University : August 1984.

The main concern is how logic programming can be useful in education rather than the narrower aim of simply learning to use a particular version of Prolog Logic programming which is now fairly widely used in 5th generation artificial intelligence work.

Cumming, G. The Computer and Learning to Read : Towards a Discipline of Education, in A.D. Salvas (Ed.) *Computing and Education – 1984 and Beyond.* Computer Education Group of Victoria, Melbourne : 1984. (Proceedings of the sixth annual conference of the C.E.G.V., La Trobe University, 1984.)

The paper discusses method in educational research, learning to read as an example of the educative process under research and moves to the application of computers for research and CAI.

Cumming, G. 'Computers come to school, but psychology hasn't noticed', in *Australian Psychologist :* November 1984.

The aim of this paper is to discuss the computer led change in education, the roles that psychologists should be playing in it and the benefits it can have for psychology. It focuses on computers, though many of the same considerations apply to other new technology. The final sections of the paper explore the prospects for better theories of learning, and the most promising developments in educational computing: those based in cognitive science.

Cumming, G. & Richardson, J. 'Logic Programming : Prolog and Education', in A.D. Salvas (Ed.) *Computing and Education – 1984 and Beyond.* Computer Education Group of Victoria, Melbourne : 1984. (Proceedings of the Sixth Annual Conference of the C.E.G.V., La Trobe University : May 1984.)

The aim of this paper is to introduce Logic programming, to describe what has been done in schools and to sketch some educational possibilities.

The nature of any language influences what thoughts we can have or messages we can express in that language. As a computer language logic programming is quite different from the familiar procedural languages, so it is likely the patterns of thought and expression it elicits are different also. It probably allows us to represent and think about problems and knowledge in a distinctive way, a way emphasizing clear, precise specification rather than sequences of operations.

Dayman, J.M., Driver, B.E., Keightley, J.V. & White, D.M. *Technological Society : Meeting the Challenges.* Implications of Present Social and Technological Changes for Curriculum. Presented to the Annual Conference of the Australian Association of Institutes of Inspectors of Schools by the South Australian Institute of Inspectors of Schools, Perth : 1984.

This paper outlines the South Australian Education Department response to encourage curriculum developers to take full cognizance of the changed social and technological circumstances confronting schools.

Social impact, cultural diversity, environmental awareness, living/survival skills, literacy etc.; technological impact and distribution

ending with a section on "A Technology Strategy for South Australia".

Department of Science and Technology *National Technology Strategy* – Discussion Draft : April 1984.

This work evolved from the National Technology Conference in 1983.

"Science and technology have a central role to play in Australia's economy by revitalizing existing industries and encouraging the growth of new ones". The major problems relating to the transfer, ownership, adoption and employment effects of technology are not technological, but social, political and cultural.

The national priorities are listed as: (1) Raising Australia's skill base; (2) Bridging the gap between research and industry; (3) Moving the Australian economy away from high bulk, low value added exports to high unit value and low volume; (4) creating stronger and more appropriate economic structures capable of identifying market riches, producing goods which can be placed on a world market; (5) overcoming the problems of overspecialized regional economies.

Policy principles: A vital and flexible R & D is needed, with extensive government support. *Objectives:* provide innovative R & D infrastructure; increase R & D in Australia to the critical mass where it becomes self sustaining; increase private sector R & D to improve the balance between sectors, ensure young and able researchers are able to obtain employment in R & D; couple the tertiary education R & D effort more effectively to the needs of commerce, industry and the community. *Action:* ensure an adequate supply of well trained researchers by increasing participation in undergraduate and postgraduate education; increase the number of long term (5-7 years) contract non-tenured positions in tertiary institutions; establish centres of concentration of expertise; encourage and facilitate regional or national sharing of major items of equipment or facilities; establish technology oriented data banks to improve information dissemination; etc.

Department of Science and Technology. *Social Implications of Technological Change.* Policy Information and Assessment Branch, Department of Science and Technology, June 1984.

Education Department of WA. *Computers in Primary Schools.* Discussion paper No. 9, March 1981.

This is a discussion paper for the formulation of policy on the introduction of computing equipment into primary schools. It outlines costs and probable uses of microcomputers in primary schools.

The Education Department of Western Australia is currently supporting a significant effort in the area of secondary school computer education, viz.: Ways of communicating with a computer, ways of controlling a computer, capabilities and limitations of a computer, and the impact of computing technology on individuals and society.

The limited amount of computer education that has taken place in primary schools has usually occurred as a result of the enthusiasm of a particular teacher, and sometimes with the support of an enthusiastic and/or knowledgeable parent.

The paper discusses the merits of hardware systems, languages etc. available, together with software options and finally lists levels of support and action available to the department.

Hall, W., Lowe, I. et al. *Teaching Science, Technology and Society in the Junior High School.* Brisbane College of Advanced Education : 1983.

A booklet for science teachers preparing the topic *People, Science and Society* in the Queensland Junior Science Syllabus. S/T/S is an approach to science education where the interactions of science, technology and society play an important role. Describes science and technology as part of our culture and describes the interaction between S/T/S.

Hammond, J. *Musical Chairs in the Computer Industry.* Australian Computer Society (NSW) Annual Conference, Terrigal : 1980.

Discusses the ways in which technology may alter the traditional roles of women both in the household and in work. It suggests technology will encourage women to join the labour force.

Hawthorn Institute of Education. *Technology Education as part of General Secondary Education.* Curriculum Programmes Section, Education Department of Victoria : June 1984. An Australian contribution to the UNESCO Pilot Project on Technological Education.

This paper uses case studies to show ways in which technology education can be included as a component of existing subjects so that the material may be used as a guide in their own setting. The writers of this paper disagree that technology education should focus on high technology: "The procedures of thinking and doing that are characteristic of technological development can be understood and practiced with "simpler" technologies in ways which emphasize the generality of their application and their links to human purpose.

The case for technology education in general is put on the grounds of: (1) we are living in a post industrial era (2) unprecedented rates of technical development and social change (3) more and more of our environment is human made (4) the need to understand the relationships between humans and machines (5) human achievements are used as a basis for examination of culture, human thought and actions (6) technology involves making, using and doing what is useful, it is important to our standard of living (7) both high and low (appropriate) technology are relevant to everyday life (8) technological awareness is essential to avoid subservience to machines (9) strategies for change for the better are an integral part of technological development.

Hedburg, J.G. & Perry, N.R. *New Technology and Educational Policy*

This paper addresses the impact of new information technology in schools. It suggests that for teachers to learn the fundamentals of computing may be inappropriate but that their preparation for the use of the new information technology within the present curriculum depends upon policy decisions. The paper discusses the major policy issues for educational systems arising out of the new information technology: (i) the role of the computer within the schools; (ii) the purchase and approval of computer hardware systems; (iii) the provision of appropriate software and its pedagogical structure; (iv) teacher-training for use of technology and (v) what is the appropriate content for a computer studies curriculum?

Policy problems on the horizon: (i) the appropriate use of microcomputers in the early childhood area; (ii) the development of home based educational systems as an alternative to schools; (iii) forecast technologies which completely supplant the need to teach or learn basic skills.

Hedburg, J.G. *The Role of Technology in Education : A History of Broken Promises.* Report to the Educational Research and Development Committee, September 1982.

In the early stages of enthusiasm, there are many promises made for each new technology and often, in the light of these claims, the technology is found wanting. The report surveys research and points out the paucity of theoretical knowledge. The gap between promise and performance of technology – and the explanations thereof – are examined.

An annotated bibliography is included.

Hedburg, J.G. "The Impact of Technology on Teaching and Learning in Higher Education", in *HERDSA News,* 6(2), 9-11, 16 : 1984.

This paper discusses the report of Professor A.H. Willis on the impact of technological change on tertiary education.

This article combines critiques and responses to Willis' Report covering 'Technology and the Teaching Process', 'Devising an Integrated Framework for Assessing the Impact', and 'The Next Step'. The article looks at ways in which the new technology may be used to improve academic productivity (i.e. publishing, access to current information, etc.) and suggests it may inherently provide an incentive for academic staff so to do.

Hellestrand, G. "Political Economy of a Country in Decline". Summary of *The Politics of Establishing Australian High Technology Industry,* a paper given to the Eleventh Australian Computing Conference, published in *The Australian* : November 20 1984, p. 48.

This paper argues that the establishment of a high technology industry depends on utilizing the human skills available through government policy on purchasing technology, especially for defence and communications. It stresses the importance of 'technological sovereignty' and the need to reinforce Australian high technology industries through allocation of government contracts.

Henschke, D.T. *Technology Education : Future Perspectives.* Paper presented to the Biennial Conference of the Australian Council for Education through Technology, Melbourne : 1984.

". . . the educational argument for the increased emphasis on technology education in our schools has either been noticeable by its absence or, when attempted, is confused by the plethora of interpretations of 'technology' and the prime consideration given to information technology which, while integral to the current dynamic education, economic and social scene, is only one of a whole range of technologies which should be experienced by students."

Jackson, G. 'The Business of Research' from 54th ANZAAS Congress, in *Education News*, II : 1984.

This paper discusses the provision of research funds for higher education by the corporate sector in Australia. Institutions benefit through investor-sponsored research fellowships, extra research staff and increased research resources and recognition. This raises questions about academic freedom. The corporate contribution to university research is still relatively small but is increasing and the consequences for students, staff and institutions need careful consideration.

Johnson, R. 'Modernising the Education Industry', from a speech at the Silver Jubilee Conference of the Australian College of Education, Canberra, May 1984, in *Education News*, II : 1984.

This paper discusses current Commonwealth and State initiatives to co-ordinate Government programmes in the fields of education and training. Discusses some of the possible opportunities of Aussat, the Australian Government's domestic satellite. Calls for consideration of impact of technological change and careful planning.

Karmel, Peter 'Education and Training for Work and Leisure', in *Australian Journal of Education*, Vol. 28, No. 2 :1984.

A schema of recent implications of long-term changes in economic and social structures of Australia with suggestions for planning strategies. It stresses the importance of basic literacy and numeracy and communication skills; the need for traditional educational institutions to adapt structure and curricula to meet the new needs and motivations – without sacrificing standards, i.e., he suggests a move away from relative assessment in favour of absolute standards of competence.

Generally, it focuses on youth oriented solutions, but touches on increasing early retirement, and changing the employment base

toward the service sector. It argues for resources to raise educational participation in post-compulsory schooling, tertiary education and training, and such reallocation of resources as is necessary to raise the minimum competencies to be achieved during compulsory schooling.

Keating, R. "Microcomputers in Education : Trends in New South Wales." *National Microcomputer Conference on Personal Computing for the 80s.* Australian National University, Canberra : July 1980.

This paper addresses itself to some of the fundamental questions concerning computer education in N.S.W. secondary schools. It describes the process involved in the NSW Department of Education recommendations regarding microcomputers. It contains a brief summary of systems employed in other states and gives the criteria established for the final choice of microcomputers for the school environment, including short and long term considerations.

Keulamans, T. and Skertchly, A. *Futurology: Proceedings of the First National Symposium on Methodologies for Social and Technological Forecasting.* Caulfield, Melbourne, 1979.

Papers in this collection cover the nature of the problem of forecasting through to specific methodologies practised by "Futurologists". Themes include Futures in Education and Training, Technology Assessment, Technology and Society, and Technology and Assessment. Methodologies presented include trend extrapolation, the Delphi technique, cross impact analysis, dynamic simulation and modelling, and scenario generation and utilization.

King, R.C. "Significance of Technological Change for the Future Structure and Organization of Australian Tertiary Education." Paper presented to *Challenge and Change Conference,* Darling Downs Institute of Advanced Education, Toowoomba, Queensland : July 1984.

This paper attempts to pinpoint certain aspects of tertiary education upon which technological change could be expected to have significant influence.

King discusses the significance of technological change in tertiary education, and strategic planning as proactive and reactive necessity in tertiary education. He concludes the most noticeable developments at the system level are likely to be in the areas of distance

education, external studies and off campus study centres. The impact of technological changes is likely to be felt more at the individual institution than in the central authorities.

King, R.C. "The Relationship Between Technological Change and Education", in S. Hill and R. Johnston *Future Tense? Technology in Australia.* Queensland University Press : 1983.

The paper includes analysis of social implications of policy implemented "in the context of broad educational and social planning strategies" or "in the context of short term economic (and especially industrial) expediencies." Also discussed is the constant difficulty of welding together and fulfilling the several legitimate goals concurrently pursued by education systems and institutions.

The assumption that education systems in Australia can be 'fine tuned' for purposes of managing technological change and unemployment is challenged. A section on education for leisure is also included.

Kramer, Dame Leonie "Machines could stifle creativity", unpublished speech to the Printing and Allied Trade Employers Federation based on interviews between Franz-Oliver Giesbert and Joseph Weizenbaum, Professor of Computer Science at M.I.T. reported in *The Sydney Morning Herald :* April 21 1984.

"The introduction of the computer into any problem area, be it medicine, education, or whatever, usually creates the impression that grievous deficiencies are being done. But often its principal effect is to push problems even further into obscurity -- to avoid the need for fundamentally critical thinking."

Lally, M. & Macleod, I. Development of skills through computers: Achieving an effective, enjoyable learning environment, in *Impact of Science on Society (UNESCO),* Vol. 32, 1982.

This paper discusses the advantages of certain types of computer-based instruction in basic skills. The main concerns are on motivation and directing students' attention to appropriate learning materials.

Lally, M. & Mcleod, I. Computer-based management and delivery of special education services, in A. Sale & G. Hawthorn (Eds.)

Proceedings of the 9th Australian Computer Conference, Hobart, 1982.

Describes a model whereby appropriate support services can be delivered to educationally isolated students. It is suggested that instruction can be largely computer-managed so that only unusual cases are flagged for teacher attention. The interaction between computers and communications is also described.

MacKay, G. Some Undertows of Computer Education, in *Information Transfer*, Vol. 4, No. 1 : April 1984.

Issues covered include: Involvement with computers; fitting computers into your concept of schools and learning; measuring (technological) progress; political questions posed by computers; side effects of computers in schools; relation of school computers to home computers; and educational issues – balancing computer courses with ones on 'communication' and 'interpersonal relationships'; developing experimentation in classrooms.

Malcolm, C.K. & Stephens, W.M. *Curriculum Development in Technology Education.* AARE Annual Conference, Perth : 1984.

This article reports on a curriculum development project undertaken in Victoria and draws attention to issues of classroom management and teacher behaviour that arise in teaching technological design and problem solving, and it presents some preliminary findings from the technology education project.

It rationalizes involvement of technology education in general education because of national needs for an appropriately skilled work force, and because of the needs of individuals to come to terms with their environment and have power within it. Technology education has general pedagogic value as a vehicle for personal development and general education.

Mangum, G.L. *The Influence and Response of Government Policy.* US-Australian Joint Seminar on The Future Impact of Technology on Work and Education, Monash University, Melbourne : 1984.

Technology impacts upon education by the intellectual and skill requirements imposed upon those who work, through the technology of learning and through social consequences which become part of

the subject matter of education. Government policy influences the work impact of technology through the environment it creates for investment and innovation and the costs imposed by its regulations. It influences technology's impact on education through the demands imposed by the degree and kind of technological development emerging in part under the influence of policy, the resources provided to education for response to technology's impacts and the goals and objectives set for publicly supported education. Government policy responds to the education impact through its base support for education and the rules it established through which educational institutions can obtain additional categorical funds.

McDonald, Geraldine *Educational Research in a Science and Technological Future.* AARE Annual Conference, Perth : 1984.

This paper examines the definitions offered of science and technology and the arguments put forward for their role. Attention is drawn to the similarity between these arguments and those advanced a generation ago regarding investment in education and its relation to economic development. She concludes with an analysis of the likely effects on education and educational research of a concentration on science and technology.

McNamara, S. & Hedburg, J. *Designing Corrective Feedback to match Cognitive Styles for Improved Performance on Visual Problem Solving CAI Tasks.* AARE Annual Conference, Perth : 1984.

The purpose of this study was to investigate means of improving the performance of individuals on computer assisted instruction materials, utilizing visual information by examining the relationship between differences in individual learning styles and the design of feedback for the correction of errors. Specifically the study sought to examine the relationship between the cognitive style of learners (field dependence, field independence) and two types of feedback (knowledge of results, information feedback) in a programme based on visual problem solving tasks.

Michaels, Eric *Remote Telecommunications : Planning and Development Imperatives.* Australian Institute of Aboriginal Studies.

Of particular concern to the Aboriginal people is the complete absence of participation in the new technological developments:

- ABC TV via Intelsat
- Video cassette recorders
- Radio broadcasting.

There is little in the way of aboriginal content available for transmission nor adequate skills programmes to produce or even staff ground station facilities. Concerns currently expressed by community councils, Aboriginal organizations and individuals include fears that the inundation of European content via television will adversely affect linguistic and cultural tradition. It is important that the technology, programming and decision making are in local hands as much as possible.

Morrison, Perry R. 'Technological and Psychological Issues in Microcomputer Based External Teaching' in *Australian Journal of Education,* Vol. 28, No. 2 : 1984.

This article proposes the use of microcomputers as prime learning tools of external students. *Advantages:* replaces clumsy mail exchange; improved communication between students and most institutions; increased motivation through competence developed; economic advantage. *Disadvantages:* user resistance; queries on psychological impact on learning; shortage of software; information display problems.

Calls for more research on computer-education-society interaction. Suggests Austpac (Packet Switching Data Service) from Telecom is key to success of the proposal.

Murray, S. "Microcomputers in Education." *Curriculum Development Centre Conference,* Canberra : 1981.

In 1981 a 'Microcomputers in Schools Curriculum Study' team was formed to meet perceived needs in schools. Several items of software have been completed and a proposal to develop a 'computer awareness' in-service module has been accepted.

A 'Directory of Computers in Queensland Schools – 1981' is being printed, and issues of 'Computer News' have been produced.

Projects include: development of criteria for evaluation of software; construction of software; evaluating schools microcomputer installation; benchmark testing of microcomputers; investigation of the need

and format of computer-based in-service modules; support of in-service activities initiated by the departments; an update of Directory of Computers; and a 'Glossary of Computer Terms'.

It is intended to establish a network of people outside the curriculum branch (through the Regional Directors) to evaluate computer software.

Rush, Margaret *The Impact of Technological Change : Computer Aided Design.* NSW Department of TAFE. (M/fiche No. 132)

This paper pinpoints and synthesises some key issues from a School of Mechanical Engineering Seminar, 1982. There are three major categories: industrial, technological and educational. The focus is on computer assisted design (CAD) and computer assisted manufacturing (CAM). Some key areas where students skills must be developed for CAD include: keyboard skills; acquisition and use of computer language; ability to visually conceptualise design and translate onto a video display unit using a range of input devices; the ability to think holistically in terms of images and to be able to represent these showing their three dimensional attributes; the capacity to conceptualize spatial relationships between whole images and their components. Students must acquire skills in the interactive mode; staff development programmes need to be developed to update and refresh teachers' technical nowledge and skills; appropriate teaching; learning strategies and resources need to be developed.

Scriven, M. *Education and Future Technology.* ANZAAS, April 1983.

The first part of this paper presents an account of major future developments in educational technology – especially new publishing technologies.

The paper lists only the "developments with the *greatest* potential for *educationally significant* pay-off". Included are: compututors i.e. "combinations of interactive videodisk teaching machines with word processors, calculators, data base machines and multi colour graphics generators. The fundamental importance of the compututor is that it converts the present add-on costs of computer education into staff reduction/replacement costs, almost the only way in which CAI/CAL can be highly cost effective. It will do this by making

larger and larger classes manageable, ... and then in a widening range of cases by eliminating the necessity for a teacher altogether.

Also listed are: The study station; the decoder; instructional videogames; broadcast and narrowcast delivery systems; networks, radio and phones; electronics, microform and restructured publishing; and a "broader perspective on computers in Education".

Part II is entitled "The Coming Backlash Against Computer Education – and why it should be taken seriously". In summary, ". . . there will be a backlash partly because it's deserved, and partly because we haven't raised the educational craft beyond the control of fashion".

Shannon, A.G. "Technological Development and Educational Innovation", in *Studies,* Vol. 54, No. 1 : May 1981.

This paper examines the implications of technological development for educational innovation, at the same time emphasizing that teachers' responses to the issues raised depend on their philosophy of education.

Some of the advantages of computer assisted instruction can include: focusing student attention; bringing experiences into the classroom which are not otherwise attainable; preserving "one off" events and experts; making learning experiences more concrete; adding effective impact to education; visualizing theoretical or unobservable processes, giving instruction of uniform quality; providing simulated experience and realistic practice.

Shannon, A.G. *Teaching, Learning and Computers: Some Comments.* Australian College of Education : December 1983. (Further comments on the proposed national computer education programme as embodied in the Commonwealth Schools Commission Report.)

This paper is supplementary to Shannon & Hortle (1983). It discusses curriculum development using computers as an integrating tool. In the section on Professional Development and Support Services he mentions the British Microelectronics Programme (MEP) where one third of funds is for regional teacher training activities; and as a condition for obtaining a financial subsidy for purchase of microprocessing equipment two teachers from the school must undertake a relevant in-service course. A section on software/

courseware discusses advances in programming systems that facilitate teachers designing their own software known as "Authoring Systems". The problem of balancing hardware, software and courseware potentials is mentioned, and further support for a National Co-ordinating Committee on Computers in Schools is given.

Shannon, A.G. Computers in the Curriculum, in *Unicorn*, Vol. 10, No. 3 : August 1984.

What changes, if any, should be made to the way subjects are taught in the light of developments in information processing technology?

How can we avoid training simply the elite to cope, leaving the rest overwhelmed by and critical of technological change?

One should know how to utilize the technology but also develop the intellectual skills to know how to select the information. This is reflected in what is taught, how it is taught, when and by whom. It does not mean a wholesale transformation of the curriculum, but it should result in a gradual transition where appropriate.

Shannon, A.G. & Hortle, B.A. *Computers in Schools.* Australian College of Education, occasional paper No. 4 : August 1983.

This paper is a response to proposals by the Commonwealth Schools Commission for a national computer education programme in Australian schools.

The term "computer education" is discussed. The final definition will be dependent on the relative balance of several competing factors: (i) whether computer education should be either integrated into the total curriculum or a separate subject, and at the expense of what else in already crowded courses; (ii) what is taught, why it is taught, how it is taught; (iii) who teaches computer education? (iv) who teaches the computing teachers?

Further issues covered include: (i) access to computers; (ii) teacher competence and availability; (iii) teacher training; (iv) software; (v) integrating the role of computers; (vi) expert support.

Distinctions are drawn within "computer education" to include: (i) computing: (ii) by computers; (iii) with computers; (iv) about computers.

The paper endorses the Commissions recommendations but adds reservations (a) the need for a hierarchy of interrelated goals (b) setting up a definite administrative structure to implement the programme (c) a stocktaking of computer education resources in Australia (d) de-emphasize the role of hardware with respect to software, support services etc.

Shannon, A.G. & Sekhon, J.G. *The Human Base for Technological Change.* Australian College of Education Conference, Canberra : May 1984.

As computers loom larger in the educational scene is there a danger of confusing means and ends? What do we want computers to accomplish in our schools that cannot be achieved without them? Is the duration and depth of the total educational scene an adequate basis for our immediate technological future?

We need to revive concepts such as readiness and maturation, and take advantage of the patience of the computer as an appropriate learning tool for individualized instruction on some routine tasks to free the teacher to do what only a truly professional teacher can do well. We need to re-examine *why* we teach certain subjects. Retraining of teachers is going to be of increasing importance if educators are to provide the human base for technological change.

Shannon, A.G. & Thornton, B.S. "Some Likely Effects of Computers on the World of Education", in *Unicorn,* Vol. 8, No. 2 : May 1982.

This paper outlines some of the likely direct and indirect effects of computer technology on education. These include computer based learning, the number and nature of jobs and a computer simulation of various energy scenarios, the assumption being that there is a close relationship amongst energy, economics and education.

Shannon, A.G., Thornton, B.S. & Locksley, G. "Information Technology: Some Implications for Education", in *New Education,* Vol. 5, No. 1 : 1983.

In order to make effective use of computer technology within education it is appropriate to distinguish amongst teaching (or learning) (a) computing; (b) by computers; (c) with computers; (d) about computers. The computer can also be used as an educator's tool in (e)

curriculum support applications; (f) administration applications; (g) communication applications.

Information technology will have a major impact on work – content, nature, skills, number employed, leisure time and unemployment; and on the technological environment – ways in which we transact and acquire information and how we communicate.

Sinclair, K. *Computers in Education : Teacher Friendly Software.* AARE Conference, Perth: 1984.

Details are provided of a project in which teachers are trained in the use of application software specially chosen because of its user friendly nature and its potential as an aid to teaching and learning.

Singh, J.G. & Shannon, A.G. "Advanced Education and Technological Change", in *Unicorn,* Vol. 6, No. 1 : February 1980.

Technological change, and the rate of technological change have significance for all sectors of education, but particularly advanced education, wherein the teaching is intended to have a vocational orientation and the research is supposed to have an applied basis. This paper examines some of the implications of computer technology for advanced education, and concludes that it is in providing education and not mere training that advanced education will fulfil its early promise. Furthermore, there will be a need to adapt more and more to the role of providing opportunities for re-training as the demands of the work force are altered by the speed of technological change.

Smith, B.W. *Educational Aspects of Technological Change.* NSW Department of TAFE, 1980. (M/Fiche No. 74)

Five fundamental questions are central to the current controversies about technology:

1. Is the rate of technological change itself increasing?

2. Are the new technologies (especially those based on computing, microelectronics and communications) somehow qualitatively different from earlier technologies?

3. How can our current social, political, economic and industrial institutions cope with these changes?

4. How are the costs and benefits of the new technologies distributed?

5. Who controls the technology? Who decides?

There are three main ways that technological change must influence our thinking about education. (1) The Labour Market: the part of the education system that's concerned with vocational preparation and with training must adapt to technological change. Whether the net effect on the number of jobs is negative, neutral or even positive, the old notion of a single career for life makes less and less sense. (2) Recurrent Education: retraining is the most visible and important aspect of a whole process of recurrent education; it can help us adapt to and cope with social changes, and *also* it provides the vehicle for bringing about social changes that we want. (3) Education in Technology for Democratic Choice.

State Board of Education, Victoria. Submission to the National Advisory Committee on Computer Education, August 1983.

The Board believes that new technology should open new fields of challenge and learning for all children and not be confined to attempts to improve curricula as it now exists.

". . . any proposal for computer education should be compatible with the following educational values, to which the Schools Commission, the Victorian Government and the Board are committed: devolution of responsibility and democratic decision making; fostering change and diversity to meet different educational needs; meeting needs and overcoming disadvantage among groups which have not experienced success in the education system; equality of opportunity and non-sexist arrangements and practices in education."

The Board recommends that the Schools Commission propose to the Australian Government a two stage programme of development involving: a short term proposal, designed to extend understandings about the role of technology in Australian schools and to develop more comprehensive plans for future action. There is a section on "Issues and Concerns" covering administrative decision-making, participation issues, suggesting the Schools Commission offers broad guidelines of principles. Under "Pedagogy and Curriculum Development" fundamental issues, such as views on how children learn, curriculum content etc. are discussed. Teacher development, software,

hardware, research and funding are also topics. An appendix is titled "Education and Girls" and is a statement prepared by the Equal Opportunity Office of the Director General of Education, Victorian Education Department. Questions of concern are participation rates, access, integration of computers into curriculum, "Female role models", and non sexist software.

State School Teachers' Union of W.A. *The Social and Educational Implications of Technology.* Proceedings of the SSTUWA symposium, October 1983.

A broad coverage of the issues involved with technological change. Yvonne Henderson opens with the 'optimistic' and 'pessimistic' models of technological change as a framework to discuss the costs of technology, the importance of research and transfer of technology "from Government research to industry".

Professor M. Scriven begins with an historical perspective on the role of the teacher and technology and concludes education will remain labour intensive but the curriculum will be changed as technology renders some aspects obsolete or irrelevant and, on the other hand, creates curriculum content. Examples of positive uses of technology in schools are given and teachers are urged to initate their own re-training and professional development.

Assoc. Professor Cora Baldock presents female perspectives on technological change and its impact on skills, concluding that there are no inherent reasons why some jobs are for men and some for women. She argues for a greater emphasis on the human relationship in technology and the production process.

Peter Forrest, Director of TAFE, Education Department of W.A. presents a case for adaptable, creative educational options, responsive (and relevant) to community demands. Stressing the importance of technology to the future economy he compares school participation rates between Australia, Japan and the Federal Republic of Germany. The need for closer liaison between education and the community is argued.

Furtherist Dr Alan Skertchly proposes a creative response to problems of now alienated students and school leavers outside mainstream society, a nexus of learning-earning-living activities leading to a sustainable new society.

Professor A. Morkel discusses problems of forecasting, the need to ask the right questions and not be lost in statistical techniques, data collection and extrapolation. The result of technology depends on the way in which it is employed – it can dehumanize or it can liberate.

Ms K. Nash of the Victorian Teachers Union argues that the impact of technology is clearly an industrial issue for teachers because curriculum, professionalism and the working environment are all affected. The 'good' and 'bad' road of technology are presented and under "Issues for Schooling" the problems of equity, access, sexism, learning processes, curriculum control, physiological and psychological impact, and the role of the teacher and teachers unions are discussed.

Dr H. Thompson discusses "Technology, Morality and the Social Relations of Production". It is suggested in this paper that the purpose of education should be to cut through belief systems by studying social formations as stages through which history passes; and refuse to consider any existing society, or set of ideas, as the standard or absolute to which others must be compared. Technology is seen as a process, a set of relations. The case against technological dominance is made on the grounds that human creativity, inventiveness and imagination are destroyed. Technology then controls social development leaving little room for morality and social consciousness.

Ms J. Siddens presents a blue collar perspective on the impact of technology: the fear of unemployment, the struggle to preserve jobs and the lack of altruism in managerial decision-making processes. The fragmentation of skills is described from the impact of the new machine arriving on the work floor – with unknown potential, requirements etc. The need for worker control and solidarity with regards to technological change is argued – use technology to shorten the work week and increase leisure, not to displace workers because of higher output.

K. Windschuttle offers "Perspectives from the Long Recession". He suggests the recession will continue and job prospects for the young will be conditioned by the depressed economic environment. The consequent changes in jobs available, the transition from school to work and the qualifications needed for work are not well understood even though they have profound implications for the Australian school system. Australia needs to develop a form of national

planning appropriate to our place in the world and our economic history. Economic recovery through technology in Australia is unlikely, not because of the quality of our scientists and technologists, but because of the lack of "depth of ability to turn these talents into a large viable industry".

Ms Wendy Fatin presents the views of the Federal Government, focusing on the economy, retention rates, the need for Australia to become an *active* information society. Education should be broad rather than specific (to avoid obsolescence), positive, diverse and equitable.

Dr D. Watts of the W.A. Institute of Technology, presented the "Social and Educational Implications of Technology". Beginning by saying that it was the rapidity of change, rather than the technology itself that was at the heart of the problem, he discusses the importance of education, research and development, incentives for industry and the role of the W.A. Technology Park ("a focus and an international visibility for the State's developing high technology industry and for its research and development activity").

B. Buchanan concludes with "The Effects of Unemployment" discussing the lack of rights of the unemployed and dispossessed, the extent of the young unemployed and the relation between unemployment and education. An Interim Policy Statement endorsed by the conference is included.

Sumner, B. (Co-ordinator) 'Technological Change and the TAFE Teacher : Unit Information', SACAE, Adelaide : 1984.

This unit was offered on a pilot basis for one term in 1984 to students who were largely TAFE lecturers studying on an In-Service basis.

The first section of the unit is concerned with a consideration of technological change in Australia and the history of technical and further education in Australia. The next section involves a case study and how to collect historical material.

The final section considers developments in aims, curriculum, assessment and evaluation, teaching learning methods and resources in Technical and Further Education.

The aims of the course are:

a) to understand the impact of technological change on teaching in adult and further education;

b) to recognize the general characteristics of current technological change;

c) identify significant historical technological developments in Australian industry and commerce;

d) recognise historical antecedents of TAFE;

e) analyse particular educational changes in your own specialist or related field;

f) identify influential historical trends or aims, curriculum, teaching/learning methods, materials, resources, measurement, assessment and evaluation of technological and further education courses, and perceive new and stimulating approaches to teaching TAFE students.

Sweet, R. "Australian Trends in Job Skill Requirements. A Critique of the Current Orthodoxy." US-Australian Joint Seminar, *The Future Impact of Technology on Work and Education*, Monash University, Melbourne : 1984.

This paper argues for educational responses which do not merely react to a presumed technological determinism, but for proactive responses through which education is used to shape our choices about how technology is used to influence the quality of working life.

It discusses the deskilling of many middle level occupations, and an apparent polarization in employment growth between opposed ends of the skills continuum. It is suggested that Education's response to this should not only be to ask how it can serve the needs of the economy but also how it can meet people's needs. Educational responses are required which focus on the work place where changes are occurring, and which do not just concentrate upon either producing graduates or basic literacy and numeracy skills.

Technological Change: Impact of Information Technology, 1980-1984. A series of papers published by the Australian

Government Publishing Service for the Information Technology Week Committee. Titles most relevant to Education are:

1980

Arguments for an Australian Information Technology Industry; The Role of Technology; the Third Industrial Revolution; The Impact on Society on Information Technologies.

1981

Technology and the Global Village; The Rush to 1984: The Acceleration of the Development of Information Technologies in the 1980s: Some Neglected Human and Organisational Issues; Technological Change: What the REAL Questions Are; Computers and Associated Technological Trends – Their Effects on Employment Patterns; Information and Society; Enhancing the Receptive and Expressive Abilities of Physically Handicapped People; A Microcomputer Helps Disabled Youngsters to Read; Information Technology and the Visually Impaired; Microelectronics Helping the Deaf to Hear; A Computer Training Scheme for the Disabled; Technology and its Effects on Disabled People.

1982

The Challenge of Information Technology for Management, Labour and the Community; Information Technology and the Community; Information Technology and Education; Computer Awareness, a National Asset; Information Technology Education Policy at the Systems Level; Computing From the Educationist's Viewpoint.

1983

Educational and Technological Change in the Eighties; Communications in the Service of Education; Information Technology and Society; The Shape of Society.

1984

The Employment, Education and Training Implications of Developments in Information Technology; Universities: Getting it Together; Computer Science in Australian Universities; Computers and the Gods: An Industry View of Information Technology Education in Australia.

Tillett, P.I. *Education and Technology.* A paper prepared for a meeting of the Australian Education Council on behalf of the South Australian Minister of Education, November : 1983.

This paper discusses some of the implications for education of recent and likely future developments in technology. It concludes that there is a need for a national policy to be developed regarding the kind of society and economy Australia should have in the future, and for clear national objectives to be set for education which are consistent with that policy, before programmes are designed and implemented to achieve those objectives.

The emphasis in the paper is on teaching and learning in primary and secondary school, although it is acknowledged that much education goes on in the home and work place. A section entitled "The Emerging Consensus" discusses: what to teach; who to teach; when to teach; how to teach/learn; what is needed for the above programmes? Under "The Further Steps Required", Tillett examines the likely problems, uses television as "an indication of past failures to respond appropriately to technological developments" and presents two scenarios, one advocating an expansion of the education system to capitalise on technology, and one where the expansion of technology makes schools less and less relevant.

Vickery, R.L. & Helm, M.H. *Education and the Technological Imperative.* Australian Association of Institutes of Inspectors of Schools Conference, Perth WA : 1984.

This paper has been prepared to give educators some insights into the likely future directions in relation to technological change and to the role of education. The first part sketches some of the issues likely to be generated by technological change. The second identifies some possible directions of an educational response.

Australia's poor economic performance and paucity of technological innovation has been linked with relatively low retention rates in the final years of secondary schools and with the perceived inappropriateness of school curricula. Such a thesis leads to the key role of Education in fostering economic development.

Employment trends can be expected to take the following character in the future:

a) no significant increases in employment in the mainstream economy;

b) a continuing reduction in the proportion of the workforce employed in the manufacturing sector;

c) emergence of new technologies which will generate wealth and export rather than employment;

d) new technologies which will require a small core of highly-skilled workers with a larger component of low-skilled jobs.

It is suggested the increasing participation rates in secondary education or raising school leaving age is not necessarily the key to a more skilled workforce.

Watkins, P. *Technology, the Economy and Education,* to be published by Deakin University Press, 1985.

This book covers technology trends and implications, technology as ideology, technology as control, technology skills and the work place and the relation between high technology employment and education.

It is argued that technology is not free from ideology and that its development and deployment are biased in this manner. Technology is viewed as one means of control which management can impose on its workforce. Further, it is suggested that technology has been used to deskill and degrade labour. The author questions the assumptions that technology will free people from the drudgery of work.

The role of education is viewed not as promoting specialised skills but to provide a critical understanding of the technological changes occurring in society.

Woodley, C. *Computers and Children,* NSW Education Department : 1980.

A paper for a conference of secondary and primary principles of the North West Region of the NSW Department of Education.

Woodley argues that computers are a tool and cannot replace teachers who can interact in a human capacity. Computers are motivators. He describes his experience and the advantages/disadvantages of using a computer in a primary classroom.

Windschuttle, K. "High Tech and Jobs", in *Australian Society*, Vol. 3, Number 11 : November 1984.

This paper presents comments on the work of H. Lĕvin and R. Rumberger of Stanford University whilst visiting Australia. They questioned the notion that a high tech future would demand a general increase in educational qualifications and job skills by showing that the main impact of computers, robots and the like was to deskill technicians in manufacturing and the higher grades of white collar workers. They argued that biggest job growth would be in low skilled occupations "at the bottom of the hierarchy".

Two responses to these comments are presented: one to accept them as fate – which implies avoiding unrealistic expectations from education, accepting computers as a fad and refraining from misallocation of educational resources – which Windschuttle suggests are euphemisms for cutting funding to schools. The other is to see the analyses as warnings and use them as grounds for policy change.

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The Asia and Pacific Programme of Educational Innovation for Development (APEID) has as its primary goal to contribute to the building of national capabilities for undertaking educational innovations linked to the problems of national development, thereby improving the quality of life of the people in the Member States.

All projects and activities within the framework of APEID are designed, developed and implemented co-operatively by the participating Member States through over one hundred national centres which they have associated for this purpose with APEID.

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The programme areas under which the APEID activities are organized during the third cycle (1982-1986) are:

1. Universalization of education: access to education at first level by both formal and non-formal means;
2. Education for promotion of scientific and technological competence and creativity;
3. Education and work;
4. Education and rural development;
5. Educational technology with stress on mass media and low-cost instructional materials;
6. Professional support services and training of educational personnel;
7. Co-operative studies and innovative projects of research and research-based experimentation related to educational development.

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